The Welding Engineer

Reg. U. S. Pat. Office

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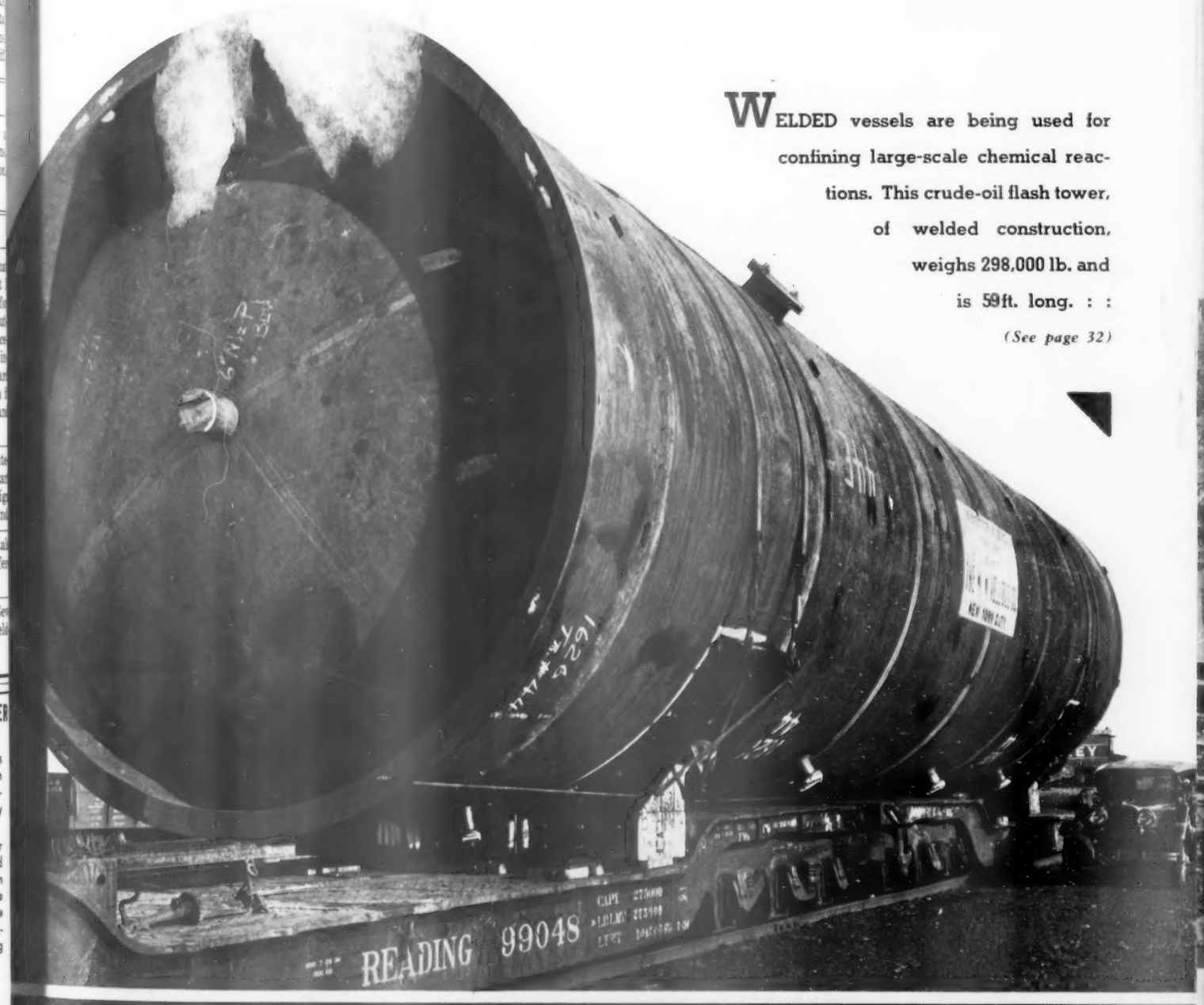
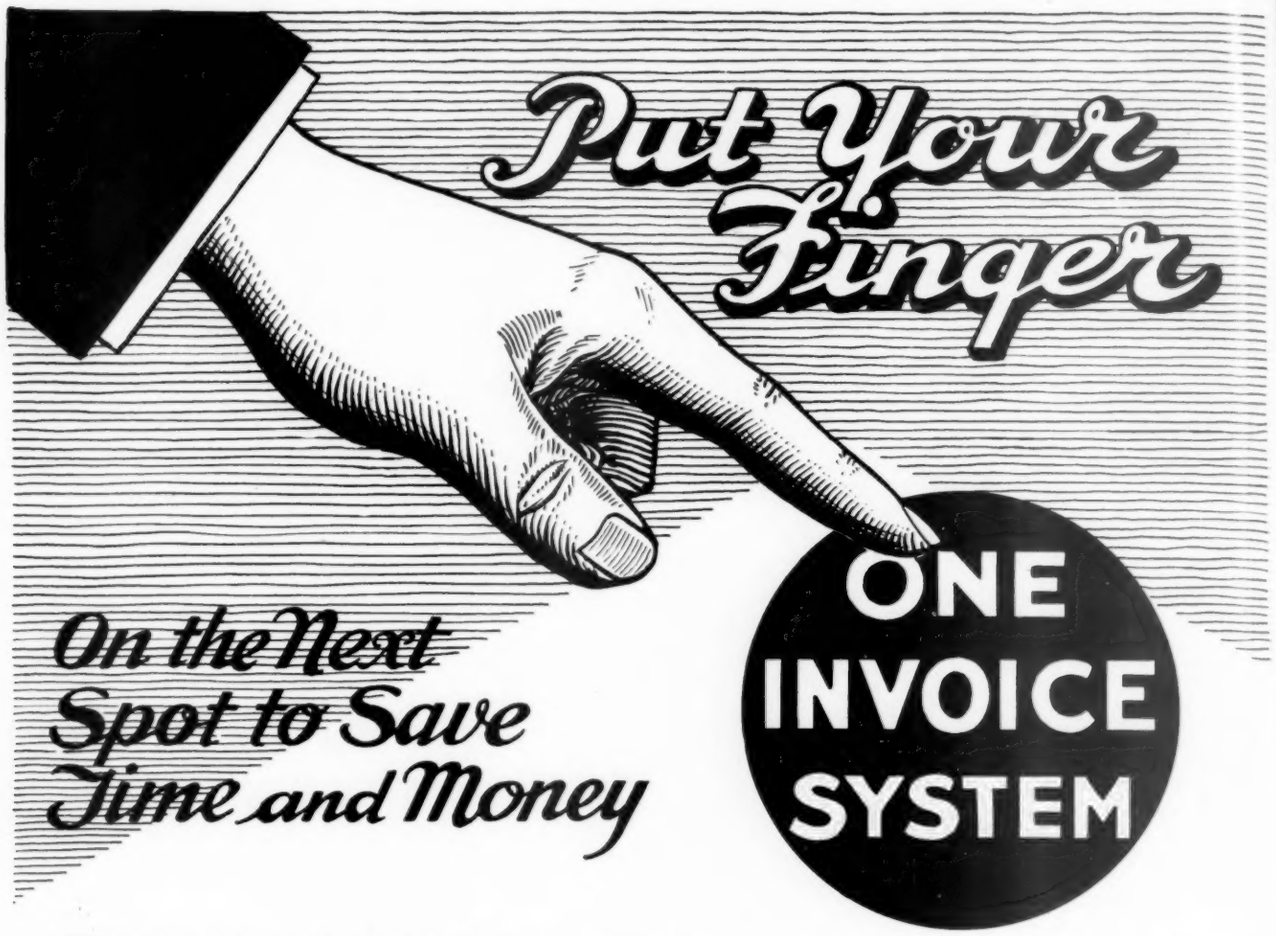


WELDED vessels are being used for confining large-scale chemical reactions. This crude-oil flash tower, of welded construction, weighs 298,000 lb. and is 59 ft. long. : :

(See page 32)

EER BUSINESS AND TECHNICAL JOURNAL OF THE WELDING INDUSTRY



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THE WELDING ENGINEER

Vol. 21, No. 2 FEBRUARY, 1936

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EDITORIAL

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Governments and Welding

● Government can't exist without income from tax levies. In 1935, $795,000,000 was collected as Federal and state gasoline taxes. Out of this amount, $265,000,000 was used for other purposes than road building. The operators of automobiles and trucks are paying a large part of today's tax bill.

As wagon prices of gasoline have gone down in the last ten years, gasoline taxes have been going up. Nuisance taxes have been applied to all types of automotive vehicles. The operator of a pleasure car or a truck is taxed at every turn.

Thanks to the increasing economies in the production and distribution of gasoline and in the manufacture of gasoline-consuming vehicles, the users of these vehicles have not yet started a mass complaint that can be taken with much seriousness by Federal, state and local governments. Even with all these taxes added, the demand for gasoline and automotive vehicles still remains at a high level.

Refinery engineers and automotive engineers have shown a high inventive ability, and the owners of automotive equipment have profited from the benefits of lower costs. But, in putting their ideas into effect, these engineers have availed themselves of the economies and structural advantages offered by welding.

It was the use of welding in the manufacture of thin-walled, high-strength pipe, and the later adoption of welding to join the sections of pipe in the field, that gave impetus to cross-country-pipeline construction. Truck tanks are made lighter by using welded alloy sheets. Leak-tight welded barges for transporting oil are rapidly becoming the rule instead of the exception. All this has resulted in economies in the transportation of oil and gasoline.

New processes enable the extraction of more gasoline from crude oil, and here welding has been indispensable in the manufacture of refinery vessels and related equipment. One authority says that if it were not for welding, the gasoline output from refineries would be 40% less than it is at present.

Without materially increasing the cost of extracting oil from the ground, deeper and deeper the wells go into the bowels of the earth. Again, welding has been of benefit in effecting economies in drilling.

Welded pipelines and refinery equipment have helped materially to reduce the cost of producing gasoline. But the gasoline user still pays about the same for the product as formerly, because government extracts in the form of taxes what the engineer has saved through cheaper processes and efficient equipment.

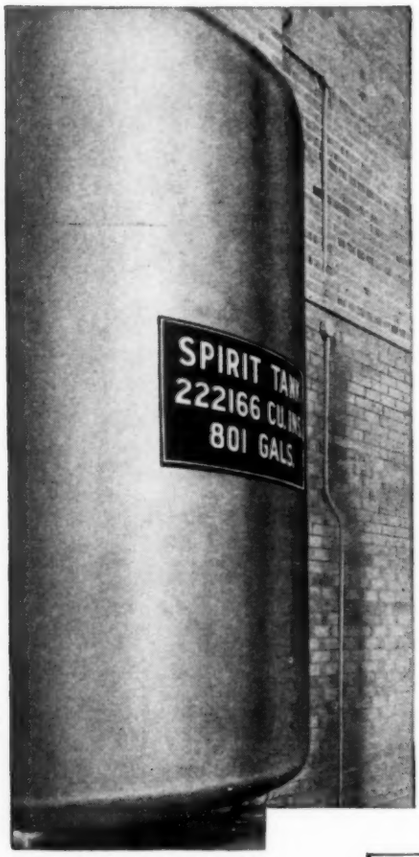
Much the same story of economies in production could be told regarding the automotive industry.

Hence it appears that welding is an important—and shall we say, indispensable—tool of Federal, state and local governments, though the connection is an indirect one.

Yes, government is indebted to the welding industry—much more so than is revealed by balance sheets and budgets.

"I get in some
GOOD LICKS *on* GIN TANKS

says NICK RODDER



Our gin tank job looked like this when finished and in place, only the new tanks were more than six times the capacity (5000 gals.).

•

Here's the sketch of the pickling basket they gave me. You can see how light it is, compared to a riveted or bolted job.

•

MONEL METAL

MY NEXT JOB is on gin tanks. Yes sir, plain or garden gin. But I get in on the job before the gin does.

She's one of a pair of 5000 gallon tanks made of 14 and 12 ga. Inconel—10′ in dia. and 11′ high. Inconel, because the gin maker wants to be absolutely sure of the purity of his product.

I get some Inconel scrap and show the welder on the job how by using ⅛" No. 32 Inconel Metallic Arc Welding rod and reversed polarity, 80 to 90 amps., we can make a swell weld. The 11′ dia. circular blanks had to be made in three pieces. That meant some long welds. The butt joints were tacked together with the edges of the sheet brought tight together. They didn't have a backing jig, so we adjusted the welding speed to get about 80 to 90 per cent penetration, then made a second weld on the underside to complete the joint. We used back-step welding to keep buckling to a minimum.

The finished job was flat as a pancake. Four of these circles were then dished and flanged, and they came through with flying colors. If that isn't a test of the soundness and ductility of the weld metal, I'm a giraffe. Which of course, I'm not.

And then Pickling Baskets

Just about the time I get over that job and

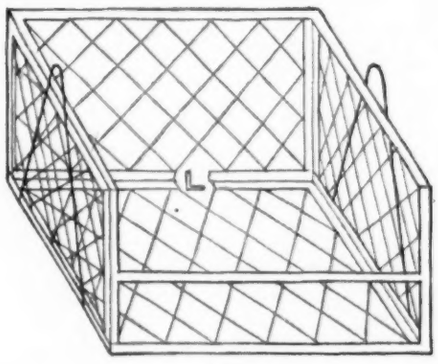


figure I can get made up on a little back sleep, a Monel Metal pickling fan calls the boss by long distance and explains how he has figured a way to revolutionize the industry by making *welded* pickling baskets, and can Nick come and lend a hand.

When I get on the job, I get handed a rough sketch like I'm showing, and the head gas welder says, "You see, Nick, we figure we can cut down our dead load by so-and-so many pounds." That's really an old story to us on the Inco welding crew, but it always seems to hit the guy that discovers it like the apple hit Ike Newton.

On this particular job, it was a manufacturer of hollow-ware who wants to weld a half dozen light weight pickling baskets. Each one is a sort of skeleton cage, 8′x5′x4′, made out of hot rolled Monel Metal angle and bar stock.

He uses 2½"x2½"x¼" hot rolled Monel Metal angle, and we weld the mitered corners with No. 43 Monel Metal gas welding rod. This is a special rod made to laugh off corrosion from pickling solutions. I use a slightly reducing flame, which makes the metal flow in easily. Each finished basket weighs 740 lbs. Compare *that* with any cast or riveted job to carry the same load!

Nick Rodder
INCO WELDING SERVICE

P.S.—The boss says to not forget to tell you how you can get our new bulletin on the "Welding of Monel Metal and Nickel" and also a handy Shop Card that shows about welding those two metals. If I talked about it all night, you wouldn't get half an idea of how handy this card is. But just drop a Govt. postal card and when you get it, you can see with half an eye that it tells you at a glance a lot about welding Nickel or Monel Metal. Write, care of Nick Rodder, International Nickel Company, 67 Wall Street, New York, N. Y.

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Carbon Arc . . . INCO Nickel Carbon Arc Welding Wire No. 21.

***for* MONEL METAL**
Oxy-Acetylene . . . No. 40 Monel Gas Welding Wire. For flux see * below.
Oxy-Acetylene . . . No. 43 Silicon Monel Gas Welding Wire.
Metallic Arc . . . INCO Monel Metal Arc Welding Wire No. 130.
Carbon Arc . . . INCO Monel Carbon Arc Welding Wire No. 20.

***for* INCONEL**
Oxy-Acetylene . . . No. 42 Inconel Gas Welding Wire. For flux see ** below.
Metallic Arc . . . Inconel Metallic Arc Welding Wire No. 32.

***for* NICKEL-CLAD STEEL**
(for welding of Nickel side)
Oxy-Acetylene . . . No. 41 Nickel Gas Welding Wire.
Metallic Arc . . . INCO Nickel Metallic Arc Welding Wire No. 35.
Carbon Arc . . . INCO Nickel Carbon Arc Welding Wire No. 21.

FLUXES
* INCO Gas Welding and Brazing Flux for Monel Metal.
** "Cromalloy" Gas Welding Flux is recommended for Inconel.
No flux is used for the gas welding of Pure Nickel or Nickel-Clad Steel.

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The Welding Engineer

VOLUME XXI | FEBRUARY, 1936 | NUMBER 2

Some Thoughts on the *Development* and *Promotion* of Arc Welding . . .

By LA MOTTE GROVER

Office Bridge Engineer, State Highway Commission of Kansas

THESE days one should not become too set in one's ideas relative to what may constitute good and acceptable practice. Especially does this statement apply to arc welding because of the earliest tendencies toward its development in this country.

The stubbornness with which some of the earlier pioneers in the field of welding have hung on to bare-wire welding has been responsible for some rather far-reaching effects, which are not all evident on the surface. Most of these effects have been bad ones, particularly from the standpoint of affecting development adversely. It is a very ill wind, however, that blows nobody good; and as is usually the case, this tendency has produced some effects, rather inadvertently, that have been of benefit.

False Principles Are Still Adhered To

The outstanding bad effect that still remains is the tendency to regard certain principles as definitely set and applicable to all processes of arc welding. This is due to the fact that limitations were so definitely fixed in the case of bare-wire welding that it became possible to formulate a very definite set of rules for welding procedure that would give best results.

And we must concede to the bare-wire camp that they have certainly done a marvelous and thorough job in developing the process for all it is worth. Insofar as the equipment and supplies were concerned, there was nothing to work on but the wire and the power plant for furnishing welding current. Both of these have been developed to a very high degree of perfection—to a much higher degree than would likely have been the case if there had been other opportunities for developing the process to produce better quality. Fortunately, these developments have been of value in advancing modern shielded-arc welding; and this is one of the beneficial effects that I have in mind.

WELDING progress would be hastened by discarding those principles that have been handed down from the days of bare-wire welding, and which are not valid when applied to shielded-arc welding, points out Mr. Grover. Manufacturers' service organizations still are needed to promote good welding practice.

Another, is the realization at an early period that welding is a process that requires considerable skill and practice. Although it requires just as skilled an operator, at the present state of development, I believe, to make thoroughly reliable welds with the use of the shielded-arc process as with bare wire, nevertheless a beginner can strike and hold some kind of arc with a shielded electrode must easier than with bare wire. I might even go so far as to say that in the earlier stages of development, we might have produced poorer work and might have had more welding failures with good electrodes than with bare wire, just because there would have been more inexperienced operators plastering on weld metal of fairly good appearance without getting proper fusion and other characteristics necessary for good welds.

Providing Trained Operators Is Greatest Problem

I have emphasized this point about the skill of operators, not particularly as a matter of reminiscence, but because it is perhaps the most common stumbling block encountered when one starts out to use the arc-welding process. From everywhere comes the same report, that the greatest difficulty encountered today is the problem of providing properly trained operators.

Many welding departments of fabricating shops and industrial firms have not provided proper control and training facilities and depend largely upon the requirements of the engineer to determine when their operators have gained sufficient skill to be allowed to do important work; and the engineers in general have not yet fulfilled their duties in this capacity. Engineers in charge of welded construction must exercise particular vigilance with regard to the qualification of operators until such time that the welding shops establish more reliable facilities for control and training by their own organizations.

This leads to another very important point to be emphasized in connection with the promotion and development of arc welding. There are too many manufacturers who feel that arc welding has been sufficiently developed and enough operators have been trained throughout the country, that nothing remains for the manufacturer to do but get his

products sold and accompany them with a slip of brief printed instructions to point out any special technique or procedure that may be required for their use. No greater fallacy relative to welding development exists today; and unless manufacturers recognize that for a time at least it is absolutely necessary for them to provide competent and extensive service organizations to aid in establishing good practice in the field, a wide-spread use of welding will not be adopted very rapidly for important fabricated structures. Furthermore, the rapidity with which developments are taking place leads one to wonder if there will ever be a time when it will not be necessary for manufacturers to furnish quite extensive service facilities in connection with the marketing of arc-welding supplies and equipment.

Under the present system of cut-throat competition, manufacturers are selling on such a small margin of profit as to leave an inadequate amount for financing a service organization. However, it is simply up to these manufacturers to agree upon the necessity for providing such service for the good of the industry in general, and to sell at enough profit to cover the cost of the service that must be given.

Should Show Appreciation for Service Rendered

While it may appear hopeless to effect such agreements between manufacturers, relative to selling prices themselves, the same thing can be accomplished by agreements relative to service to be provided. I believe that such agreements could be reached by all companies that are big enough to "cut any ice" in the field. This would eliminate the very unfair burden that is being placed upon some of the more conscientious manufacturers who are carrying much more than their own share of the burden of cost at the present time. There is one way in which users of the arc-welding process can help greatly to bring this about, and this is to show appreciation for such services when they are rendered.

Just to mention a few of the changes that have been made and are being made in welding procedure as a result of improvements and developments in electrodes and equipment for arc welding: A very definite preference for side or longitudinal fillet welds which existed with bare-wire welding and was quite proper under those conditions, has been giving way rapidly to a preference for butt welds and more end or transverse welding where a choice exists. The old practice of using ⅜-in. intermittent fillet welds as standard, unless a larger size is found necessary to provide strength, is giving way to the use of such sizes as 5/16-, ¼-, and even 3/16-in. continuous fillets where they provide sufficient strength.

Modern Procedures With Regard to Bead-Laying

When the shielded arc was first developed, straight beads were the proper thing almost without exception, because of the way the pool of molten metal behaved; and it was quite a while before procedures were developed for welding successfully in the vertical and overhead positions as a practical operation. The sizes of electrodes that could be used on work requiring best quality were restricted to ⅛-in. for vertical and overhead and 3/16-in. as the very maximum for flat work. Now 5/32-in. is commonly used with excellent results for vertical and overhead, and in some cases 3/16-in. electrodes. There is no doubt that if an operator is sufficiently skilled, he can produce excellent welds with ¼-in. electrodes in the flat position; and in some cases even larger sizes can be used appropriately for the work in question. With bare wire, 3/16-in. diameter had to be recognized as a maximum for anything but the poorest class of welding.

Weaving to a width of three diameters of the electrode used, is surely permissible with modern procedures, and for some purposes a wider layer can be deposited properly. In fact, with special electrodes, such widths of weld metal deposits are possible without weaving, because the process conserves the heat sufficiently to accomplish thorough fusion, and distributes the heat properly, retaining it long enough for shrinkage stresses to be relieved quite largely. But such electrodes have not yet been developed to the point where they can be used without rather particular skill and training.

A considerable depth of fusion, sometimes called "penetration" (but without reference to penetration into corners), was thought to be absolutely necessary not so long ago; but electrodes have now been developed that permit very thorough fusion without melting the base metal to any appreciable depth.

Stress-Relief Bugaboo Scares Some Away

One of the favorite alibis of those who still hesitate to use welding despite the reliability that has been demonstrated for the process when it is properly controlled, is that stress-relieving or annealing is necessary for good work, and the class of work in which they are interested does not permit of any kind of subsequent heat-treatment. Those who make such claims should go into the modern welding shops of some of our larger industrial firms and see the excellent results they are accomplishing, as evidenced by metallography studies, without the use of any kind of heat-treatment following the welding. In fact such heat-treatments, unless very carefully controlled by someone with thorough experience, are likely to result in more harm than good.

The adverse early attitude toward alternating-current welding is gradually giving way in the face of the development and marketing of fully adequate a.c. welding equipment. Although we may look for d.c. welding to hold the field (at least for a long time yet in the majority of cases), a.c. welding has become established as a reliable process with the use of the shielded arc, and certain rather definite advantages have been demonstrated for it under the conditions most favorable to its use.

Special Electrodes Promote Use of New Alloy Steels

The field of special steels, such as the German high-carbon ST52 steel and the low-carbon alloy steels that are rapidly gaining popularity in this country, is one in which the possibility of producing good, reliable welds has been very definitely limited as a practical operation, especially for structures that could not be given subsequent heat-treatment. Special electrodes have been developed to meet many of these problems successfully, and I believe that we may look for further rapid developments, especially in the use of our low-carbon alloy steels for welded construction.

No one can predict what may happen in the way of developments in arc-welding procedures. We cannot afford to take up with every wild scheme that is proposed, but we shall certainly have to remain open-minded toward accepting new developments as they become properly established.

Requirements for Boiler Repairs by Welding

A revision, carrying the approval date of Oct. 24, 1935, has been issued on "Requirements for Repairs by Fusion Welding on Boilers and Pressure Vessels," by the National Board of Boiler Pressure Vessel Inspectors, Columbus, Ohio. In addition to several minor changes in the former published requirements, these regulations specify a test for welding operators engaged to re-end or piece tubes of fire-tube boilers, where such re-ended tubes constitute more than 50% of the total number.

The A. S. M. E. Boiler Code Committee has passed upon these requirements and has formally taken action, calling attention to the fact that the revised rules should give safe results.

California Pipeline Awards Total $7,500,000

Two contracts that will include a great amount of welding have been awarded by the Los Angeles Metropolitan Water District. These involve sixteen miles of concrete and steel pipelines for the distribution system of the Colorado River Aqueduct, and will total in cost approximately $7,500,000.

The Western Pipe & Steel Co., of Los Angeles, was awarded the first contract, which calls for about 10½ miles of welded steel pipe and a 900-ft. steel bridge to span the Santa Ana River. The pipeline will vary in diameter from 9 ft. 8 in. to 11 ft. 6 in.

The American Concrete & Steel Pipe Co., of Los Angeles, received the second contract, for approximately 6 miles of pre-cast, steel-reinforced, concrete pipe, 11 ft. 8 in. in diameter. Much welding will also be used in the reinforcing steel for the concrete pipe.

Steel Company to Make Survey of Welding

Robert E. Kinkead, widely-known consulting engineer on welding, has been retained by the Carnegie-Illinois Steel Corp. to make a survey of their welding operations. Mr. Kinkead is a mechanical engineer, Ohio State, 1913, and has specialized in welding throughout his entire career. Since 1927 he has been engaged in professional consulting work for a number of engineering and manufacturing companies who are large users of welding. His home is in Cleveland.

Robert E. Kinkead Will Make Welding Investigation for Carnegie-Illinois Steel.

Kansas to Hold Its Second Welding Conference

The Second Annual Welding Conference of the School of Engineering, University of Kansas, Lawrence, Kan., will be held in Marvin Hall on Thursday and Friday, Mar. 12th and 13th, according to an announcement from A. H. Sluss, professor of mechanical engineering. Exhibitions and demonstrations will be held in Fowler Shops. The tentative program is as follows:

Thursday, March 12th

9 a. m. Registration.
"A Word of Greeting," by Dr. E. H. Lindley, chancellor, introduced by Geo. C. Shaad, dean of the School of Engineering.
"The Design and Testing of a Miniature Welded Structure," by Geo. W. Bradshaw, associate professor of civil engineering.
Paper on the use of gas in welding operations, by a representative of The Linde Air Products Co.

1:30 p. m. "A. C. Welding," by O. A. Tilton, welding engineer, General Electric Co.
Paper on electric welding by a representative of the Air Reduction Sales Co.

7 p. m. Exhibition of metal cutting and metal spraying, by the Air Reduction Sales Co.
Inspection of welding equipment.

Friday, March 13th

8:30 a. m. "The Metallurgy of Welding," by E. D. Kinney, head of the department of chemical engineering.
"Shielded-Arc Welding," by Robt. Notvest, engineer, J. D. Adams Co.

1:30 p. m. "Use of X-Ray in Examination of Welds," by Leonard T. Detlor, senior mechanical engineer, University of Kansas.
"A. C. vs. D. C. Welding," by W. M. B. Brady, General Electric Co.
Paper on use of gas in welding, by a representative of the Air Reduction Sales Co.

7 p. m. Inspection of welding equipment.

Cleveland Selected for National Metal Congress

The 1936 National Metal Congress and Exposition will be held in Cleveland's Public Auditorium, October 19th to 23rd, inclusive, it has been announced by W. H. Eisenman, managing director of the Exposition and national secretary of the American Society for Metals, which annually sponsors this event. The Fall meeting of the American Welding Society will be held at the same time and place.

Cold Weather Makes Work for Welding Units

Hundreds of welding machines have been kept busy during the past month thawing out frozen pipes and mains, resulting from the prolonged cold weather. The length of time required for a thawing job ranges from 5 minutes to several hours, depending on the size of the main, the length of the completed circuit, and the number of amperes. Currents of 200 to 500 amperes have been used successfully. Sometimes the welding shops do this work themselves, and in other cases they rent the machines out. The price varies widely, but where the shop does the work the average price is about $5 per hour, based on all the time that the machine is away from the shop.

On such jobs, one must take care not to overload the generator. This point especially deserves watching where the job requires more than an hour. Because a generator can be used continuously on a welding job without heating, does not imply that it will remain cool on a pipe-thawing job, though delivering the same current. The difference lies in the fact that all welding operations are necessarily intermittent, even in the case of long seam welding, inasmuch as the operator must change electrodes every so often. On a pipe-thawing job, however, the current flows steadily unless purposely interrupted.

All NEMA ratings on welding generators are based on continuous rated current for one hour. If rated current is delivered for longer than one hour, continuously, the generator may overheat. Therefore, if a thawing job requires more than one hour to complete, the generator should be shut down for 10 or 15 minutes during every hour. If it is desired to operate continuously for longer than an hour, the generator should be adjusted to deliver only about 80% of rated current. If the current delivered is greater in amperes than the machine's rating, overheating may occur in less than an hour, the time depending on the amount of excess current.

The Water Department of the City of Chicago has issued the following "Hints" on thawing water pipes:

1. The voltage should be kept low to prevent injuries to persons, curb stops, plumbing, etc.
2. Connections of the electric cables to the pipe should be made as carefully as possible, scraping the surfaces to give best contact.
3. The distance between connections should be as short as conveniently possible.
4. Connections to service should be, if possible, outside of any light, telephone or other wires that may be grounded on the plumbing.
5. All connections should be tightly and securely made.
6. The main switch or fuses of the lighting circuit should be disconnected.
7. The water meter should be removed from the line.
8. Connections to a curb stop should be avoided if possible as it may be damaged or its lubrication destroyed.
9. Connections can be made to corporation cocks set in line, fire-hydrant nozzles, valve stems or other good and safe connections.
10. Wrapping cable around a coated main is not preferred if a better connection is available.

We understand that considerable damage has been done in thawing with electrical apparatus where it was tried to force the current through the line too rapidly at a high voltage.

Where the mains are jointed with Leadite or metallium, we learn that electric thawing is possible through a reasonable length of pipe, unless there should be a decided break in the circuit, such as might be caused by a sleeve joint.

Six-inch and 8-in. mains have been thawed with connections as far as 200 ft. apart, or more, where just the ordinary bell-and-spigot joints are in the line. So far, it has been found impossible to complete a circuit and pass current where there are sleeves or like gaps in the line. In such a case it would be necessary to divide the length of the line into shorter sections until the location of such gap can be found. This could be done by excavating, or driving rods for contact points along the line of pipe.

One water company reports recent results as follows, for cast-iron mains with Leadite or metallium joints:

Size of Pipe	Amperes Required	Approx. Length of Pipe	Approx. Time Required to Thaw
¾ in.	250	300 ft.	3 to 10 minutes
1 in.	300	250 ft.	5 to 10 "
2 in.	400	150 ft.	15 to 30 "
3 in.	500	100 ft.	30 to 60 "
6 in.	500	225 ft.	2 hours

Oxy-Hydrogen Welding of Tea-Kettle Spouts

The Welding of Aluminum

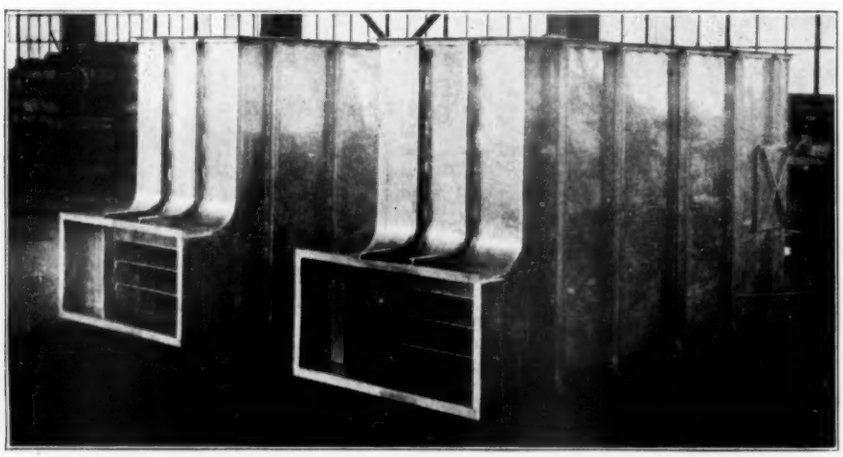
By G. O. HOGLUND
Aluminum Company of America

THIS year marks the 50th anniversary of the discovery of the process for producing aluminum on a commercial basis. The commercial welding of aluminum dates from about 1910.

THE introduction of aluminum as an engineering material followed soon after the discovery in 1886, by Charles Martin Hall, of a commercial method of producing the metal. The early history of aluminum is a fascinating story of rapid growth and of the adaption of the then existing fabricating practices to new uses found for this metal.

In the first years of the twentieth century, the welding torch was being developed into a joining tool of commercial significance. At the same time, the production of aluminum cooking utensils provided a field where the use of welded joints was imperative in order to provide sanitary construction as well as to bring the cost of these articles down to a competitive point. It followed that the art of welding aluminum developed in this country from the early applications on cooking utensils.

The early method of welding aluminum utilized a hydrogen flame burning in the atmosphere. At first, no attempt was made to remove the oxide coating with which aluminum is covered. As a result, this coating prevented smooth coalescence of the weld rod with the parent metal. By stirring and puddling the molten metal, welds could be made; but judged by the standards of today or even by contemporary standards of that time on other metals, the welds lacked soundness and consistency.



Glass-Drying Equipment, Made From 3S Alloy, Assembled by Metallic-Arc Welding.

About 1910, a signal contribution was made to the welding art when, under the direction of Dr. Earl Blough in the laboratories of the Aluminum Co. of America, a welding flux was developed that made aluminum one of the most readily weldable metals. A further improvement was obtained with the introduction of the oxy-hydrogen torch, which speeded up the operations. This was followed and paralleled by oxyacetylene welding. Basically, the process as then established is substantially the same as is used today.

The technique of welding aluminum with the gas torch is much the same as with other metals. Those familiar with the welding art readily recognize the

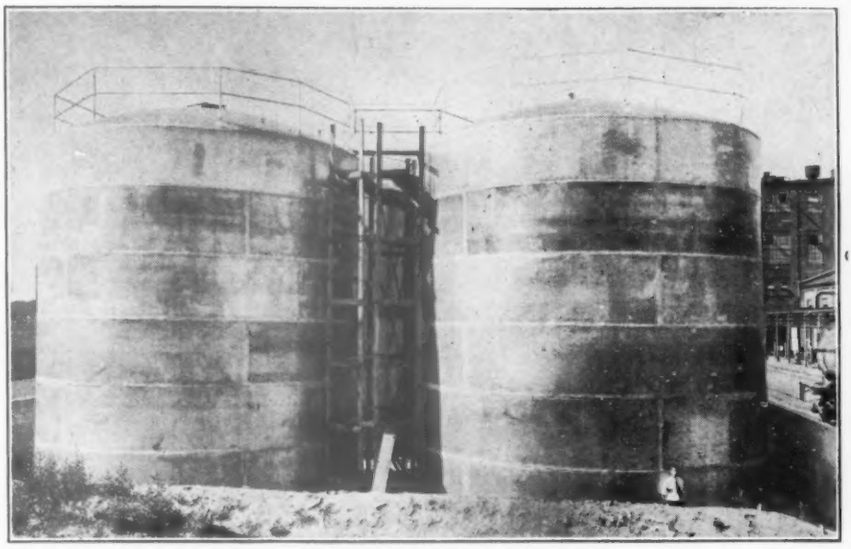
w melting point and high fluidity of e molten metal, and with some train- g can make sound, neat welds on alum- um parts. The development of weld- g technique is merely a matter of oper instruction and practice.

Choice of Wire and Process Depends on Alloy to Be Welded

By alloying aluminum with suitable etallic constituents, a number of com- ercial materials have been developed at are finding wide use. Not all of ese alloys can be considered where elding is to be used for joining. On e type of work where welded joints e desirable from the standpoint of eco- omical first cost and the service in- nded, it is imperative that the correct mbination of alloy, welding wire and elding process be chosen.

Commercially pure aluminum, or 2S, welded on a production basis by al- ost all the common welding methods. his alloy is welded with the gas torch, etallic and carbon arc, and also re- istance welded, with excellent results. An alloy of aluminum and 1.25% man- anese, designated as 3S, has substan- ally the same welding characteristics s commercially pure aluminum and has e advantage of higher mechanical roperties.

Alloy 3S and commercially pure alum- num are supplied in all the commercial orms, such as sheet, plate, tubing, rolled nd extruded shapes, wire, rod and bar. he temper of the material in the vari- us forms is dependent on the amount f cold work the material receives during abrication. The strength of welded as- emblies made from these materials, however, depends upon the strength of the alloys in the soft temper, because of the annealing effect of the welding heat. Regardless of the temper of the material welded, the average strength of butt welds in tension for 2S and 3S is 12,000 lb. per sq. in. and 15,000 lb. per sq. in., respectively.



These Aluminum Tanks, Largest so Far Assembled, Are Used for Handling Acetic Acid.
(Oxyacetylene welded in the field from 3S alloy plate. Size, 30 ft. in diameter by 30 ft. high.)

Another group of aluminum alloys has been developed, in which the mechanical properties are raised considerably by heat-treating. Not all these alloys can be welded economically, for, although sound welds can be made with the torch or the electric arc, the strength of the cast weld-zone is considerably lower than the strength of the heat-treated parent metal. On two of these alloys, however, this effect is not extensive, and welding is often used for assembling parts.

Weldable Alloys With High Physical Properties

One of these alloys, in which aluminum is alloyed with silicon, magnesium and chromium, called 53S, is characterized by exceptionally good corrosion resistance in either the welded or unwelded state, and by high strength. Consequently, this material is finding extensive application in the architectural and beer-barrel fields, where good strength and corrosion resistance, coupled with weldability, are requisites to economical application. Another alloy of aluminum with silicon and magnesium, designated as 51S, has similar strength characteristics when welded and is used in making furniture. The mechanical proper-

Torch Assembly of Factory Sash, Made of Extruded Aluminum Alloy 53S.

Table I. Typical Mechanical Properties of Wrought Aluminum Alloys[1]

Alloy and Temper	Yield Strength[2] (Set = 0.2%) (lb. per sq. in)	Ultimate Strength (lb. per sq. in.)	Elongation[3] Per Cent in 2 in. (Sheet Specimen 1/16 in. Thick)
2S-O	4,000	13,000	35
2S-¼H	13,000	15,000	12
2S-½H	14,000	17,000	9
2S-¾H	17,000	20,000	6
2S-H	21,000	24,000	5
3S-O	5,000	16,000	30
3S-¼H	15,000	18,000	10
3S-½H	18,000	21,000	8
3S-¾H	21,000	25,000	5
3S-H	25,000	29,000	4
51S-O	6,000	16,000	30
51S-W	20,000	35,000	24
51S-T	38,000	48,000	14
53S-O	7,000	16,000	25
53S-W	20,000	33,000	22
53S-T	32,000	38,000	14

[1]Young's modulus of elasticity is approximately 10,300,000 lb. per sq. in.

[2]Stress which produces a permanent set of 0.2% of the initial gauge length. (American Society for Testing Materials Specification for Methods of Tension Testing, E 8-33.)

[3]Elongation values vary with the form and size of tension test specimen. Thin sheet has somewhat lower elongation than values for 1/16-in. sheet shown in the table. Thicker material, from which standard round tension test specimens (0.505 in. diameter) are tested, may have lower elongation because of the effect of commercial flattening operations on this property.

Gasoline Truck-Tank, With Tank, Underframe and Piping Made of Aluminum.
(The use of aluminum construction saved 1100 lb. in this 2050-gallon truck-tank, and made possible an increase of 550 gallons in payload.)

ties of 51S and 53S, as well as 2S and 3S, are shown in Table I, which covers the commercial tempers of these materials.

The technique of welding, preparation of joints and specific welding practices, as well as the mechanical characteristics of the metal, have been described in detail in various publications. Reference to these sources and also consultation with experienced manufacturers of welded aluminum equipment are advisable in developing a specific job.

Brewery and Dairy Products Not Affected by Aluminum

The utility of any joining method is best illustrated by the extent to which it has been applied in practice. Research and actual practice have established that the edibility of the products handled in the brewery and dairy industries is not affected when aluminum equipment is used. It is also true that the base metal can be exposed to brewery and dairy products without coating the surface with paint or other protective coatings. It follows that the assembly of such equipment must be done by welding in order to comply with the sanitation requirements that there be no laps, seams or crevices which cannot be cleaned.

Large brewery storage tanks, fermenters, and yeast vats are made from high-purity metal, 99.5% aluminum or higher, with butt-welded joints made with the gas torch and filler wire of the same composition as the parent metal. The welds are dressed by hammering the weld bead flush with the metal surface. Welds in this material are equal in strength to the parent material and are very ductile. Stiffeners and mounting pads on the outside of these tanks are attached by metallic-arc welding.

Beer is packaged for shipment in aluminum barrels. In this case, the use of high-purity metal is not economical as it would necessitate an increase in the wall thickness and hence an increase in the weight of the barrel. By using the heat-treated alloy, 53S-T, the weight is held to a low figure. Such barrels are made by drawing two shells and assembling by a circumferential butt weld. A forged bung fitting is welded into the shell.

In dairy applications, the alloys 3S and 53S are used for tanks, coolers and milk cans. Joints exposed to milk are butt welded with 2S wire and the bead hammered or ground smooth. The transportation of milk in truck-tanks provides another field for aluminum construction where, in addition to the non-toxic properties of the aluminum shell, there is the economy resulting from the light weight of the tanks. Such tanks are made from 3S sheet with welded joints and, in many cases, insulated with aluminum foil. The weight saving in the tanks permits an increase in payload of 25% or more over steel construction.

Aluminum Containers Used for Handling and Storing Chemicals

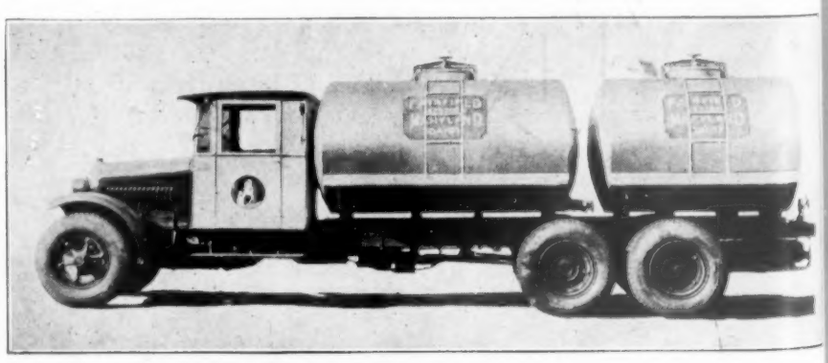
The chemical industry also finds extensive use for welded aluminum construction. Because of their resistance to attack by many chemicals, the high-purity aluminum 2S and the alloys 3S and 53S are commonly employed. Hydrogen peroxide and nitric acid are handled in aluminum drums. Welded aluminum tanks and tank cars are used in the storage and transportation of acetic acid. Welded aluminum vessels for handling stearic acid, varnish products, rayon-treating chemicals and refrigerating brines are operating successfully. Distilled water is also handled in aluminum.

Metallic-Arc Process Minimizes Buckling and Annealing

The process of metallic-arc-welding aluminum has been developed more recently than torch welding. The metallic arc has two definite advantages over the torch when welding aluminum. All the aluminum alloys have high coefficients of heat expansivity and conductivity. Because of these characteristics the expansion and subsequent buckling that take place when welding with a torch are greater than when welding steel. When using the metallic arc, however, the heated zone is concentrated and the amount of expansion and buckling is materially reduced. Furthermore, when arc welding material that has been work-hardened or heat-treated, the annealing effect of the welding heat is confined to a narrow zone because of the concentration of the arc. These advantages, coupled with the faster rate of welding, make arc welding a desirable tool for assembling parts.

Equipment for metallic-arc welding aluminum is essentially the same as that used for other metals. The standard motor-generator sets, available in all welding shops, can be used. The capacity depends on the gauge of material to be welded; a 400-ampere machine will handle welds in material up to ½ in. thick.

Both horizontal and vertical butt and fillet welds can be made in aluminum. Because of the fluidity of the molten pool, overhead welding is seldom done except in the case of local repair work. Heavily coated rod is used, and the flux coating serves the double purpose of removing the oxide coating as well as stabilizing the arc. It is not possible to



Insulated Aluminum Milk Truck-Tank and Trailer.
(A 3200-lb. decrease in dead load and a 100-gallon increase in payload were obtained in this unit.)

Table II. **Electrode Size and Machine Setting for Metallic-Arc Welding Aluminum**

Thickness (inches)	Electrode Diameter (inches)	Amperes	Rods per pound
0.064	1/8	45- 55	32
0.081	1/8	55- 65	32
0.102	1/8	65- 75	32
0.125	1/8	75- 85	32
5/32	1/8 or 5/32	85-100	32-23
3/16	5/32	100-125	23
1/4	5/32 or 3/16	125-175	23-17
5/16	3/16	175-225	17
3/8	1/4	225-300	10.5

make welds on aluminum with bare rods, as the molten metal will not flow unless the refractory oxide coating has been removed. The correct size of rod for a given job is a function of the gauge to be welded. Suggested rod sizes, as well as ampere settings, are given in Table II. The rod and flux can be bought separately, and the rod prepared by dipping the rod in the flux. However, it is usually more convenient to purchase coated rod, of which a number of standard brands are available.

The advantages of metallic-arc welding are more apparent when welding the heavier gauges of aluminum. Butt welds are generally made in sheet thicker than 0.081 in., and fillet welds in plate thicker than 5/32 in. Because of the fluidity of the weld metal, backup strips with a groove to shape the penetration bead should be used when making butt welds. A very short arc and a steady hand are essential if a smooth bead is to be made. Material up to 1/4 in. thick need not be veed or prepared for welding other than merely butting the edges; heavier material should be veed to within 1/4 in. of the bottom of the section.

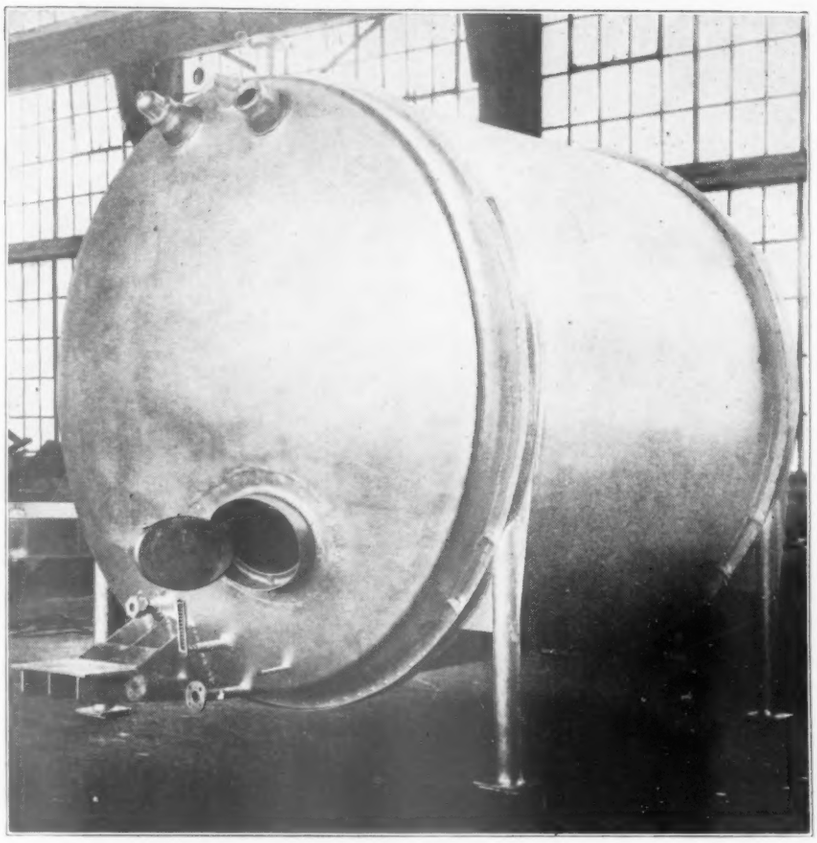
After Welding, Flux Should Be Washed Off or Dissolved

Residual welding flux, remaining after the welding operation, must be removed. This applies to both torch and arc welds. All aluminum-welding fluxes contain chlorides which, in the presence of moisture, will attack aluminum. This is particularly true if the welds are painted or finished, as the action of the flux will break down the paint coating in a comparatively short time.

There are several methods of removing the flux. Where the welds can be reached, immersion in boiling water, accompanied by brushing with a stiff fiber brush, is successful. In other cases, immersion for 30 minutes to an hour in a 10% nitric-acid solution will dissolve the deposit; this should be followed by a hot water wash to remove the acid.

The presence of flux can be detected by dropping a 2% solution of silver nitrate onto the welds. If this solution remains colorless, the cleaning operation has been successful. If a white precipitate forms, the cleaning has not been adequate, and the welds should be given an additional wash.

Spot and seam welding equipment and processes have developed to such a point that a good many commercial applications have been made that are operating successfully. Past work has established certain facts, outlined below, that are of particular interest when contemplating the assembly of an aluminum job by spot or seam welding.



Evaporated-Milk Tank, 10 Ft. in Diameter by 12 Ft. Long, Assembled by Torch and Metallic-Arc Welding.

Successful commercial fabrication of the aluminum alloys by spot and seam welding requires proper equipment and suitable supervision.

Features Required in Equipment for Spot and Seam Welding

With few exceptions, equipment designed and used for spot welding other metals is unsatisfactory for use with the aluminum alloys. A tabulation of the characteristics required for suitable aluminum-alloy work will show the reasons for this condition. Spot and seam welding of the aluminum alloys are virtually precision jobs, but if the equipment provides the following essential features, consistent and high class results can be obtained with any of the aluminum alloys:

1. Suitable electrode design.
2. A proper value of welding current for the work in question.
3. Precision synchronous timing for the highest-quality strong-alloy work, or reasonably accurate non-synchronous timing for certain jobs using common alloys.

Table III. **Approximate Machine Settings for Spot Welding**

Gage (inches)	Timing (cycles)	Current (amperes)	Electrode Pressure (pounds)
.020	1	16,000	300- 500
.036	2	20,000	400- 650
.064	4	24,000	500- 800
.081	6	28,000	600- 900
.125	9	35,000	700-1200

Cycles based on 60-cycle power supply.

Table IV. **Approximate Machine Settings for Seam Welding**

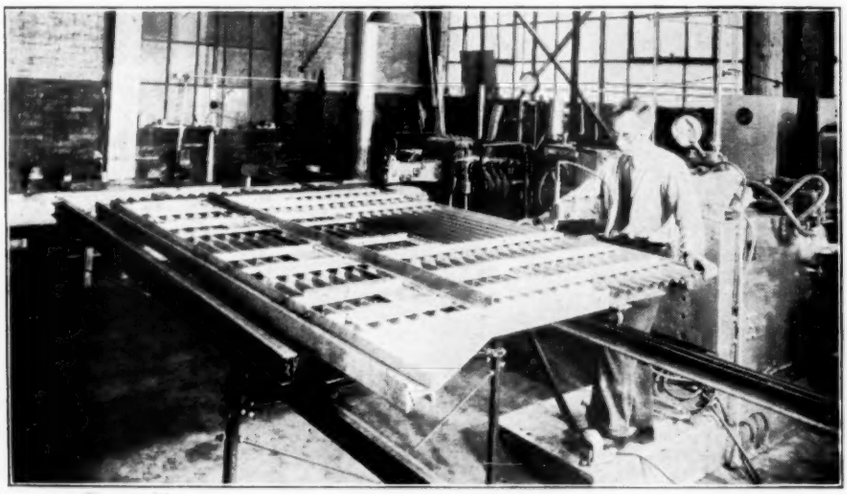
Alloy	Gage (in.)	Pressure (lb.)	Cycles On	Cycles Off	Spots per in.	Approx. "On" R.M.S. Amps.
52S-1/2H	0.025	600	1	6 1/2	18.0	26,000
52S-1/2H	0.032	680	1	6 1/2	16.0	29,000
52S-1/2H	0.040	760	1	6 1/2	14.3	32,000
52S-1/2H	0.051	855	1 1/2	6	12.6	36,000
52S-1/2H	0.064	960	1 1/2	6	11.3	37,500
52S-1/2H	0.072	1015	1 1/2	6	10.6	39,000
52S-1/2H	0.081	1080	2	11 1/2	10.0	40,000
52S-1/2H	0.102	1210	2	11 1/2	9.0	42,500

For 52S-1/4H, reduce pressure 10%.
For 52S-O, reduce pressure 25%.
For 3S-1/2H, reduce pressure 25%.

4. A quickly adjustable and accurate electrode-pressure mechanism.
5. A design of machine to minimize electrode hammer-blow.
6. Equipment to insure that the adjustments as made are maintained for successive duplicate welds.

It is, of course, easy to install any desired type of electrode on any spot welder. Most machines are provided with a fairly suitable pressure mechanism, although in many cases this is clumsy to adjust and its value is indeterminate.

The other features—sufficient current,



Spot Welding Sidewalk Panels for the Covington-Cincinnati Bridge.
(These panels were made from 0.081-in. corrugated 3S alloy sheet stiffened with 0.081-in. 3S alloy formed sheet channels.)

proper timing, and low electrode inertia —are in most cases absent to a greater or less degree in commercial spot welders.

For these reasons, best results are obtainable only with equipment specially designed to provide the desired features. Most of the major welding-machine manufacturers are familiar with these requirements and can supply equipment meeting any desired aluminum spot or seam welding application.

Table III shows approximate values of current, time and electrode pressure, and may be used as a basis for machine design.

Seam welding is merely a special application of spot welding, and all of the previously mentioned machine requirements must be complied with to obtain satisfactory results, except that low electrode inertia is not important.

Electronic control is the only known practicable method for providing the necessary intermittent power supply.

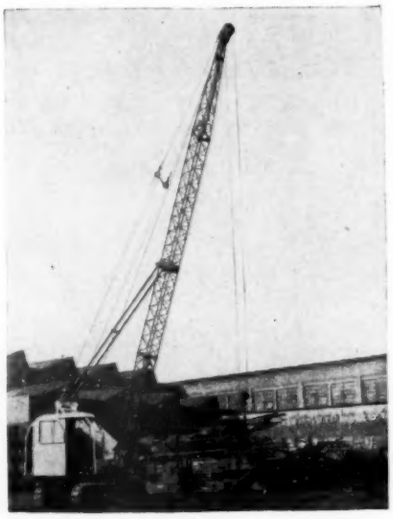
Table IV gives satisfactory adjustments for making continuous seam welds. By changing the timing and electrode roller speed, an intermittent seam weld may be made, giving the same results as if done with a spot welder but permitting a much higher rate of production.

Small Crane Has Welded Boom Made of Tubing

To meet the special requirement of a 50-ft. reach for a small bantam-weight crane, the Harnischfeger Corp., of Milwaukee, Wis., turned to light welded tube construction for the boom.

Two such special machines were recently completed for the Standard Oil Co. of California. Booms were made with two inserts of 10 and 15 ft. to double the standard length of 25 ft. It is doubtful if such unusual length could have been obtained by any other means, with sufficient lightness to be carried by a small machine weighing less than 15,000 lb. Other special equipment included high gantry and telescopic boom stops.

Although the rated lifting capacity of



Crane With 50-Ft. Welded Boom.

each machine is 1800 lb. at a 20-ft. radius, actual tests proved that the boom would lift 2150 lb. at this distance, and travel and swing loads at reasonable speed and with ample stability. Power is provided by a Ford V-8 motor.

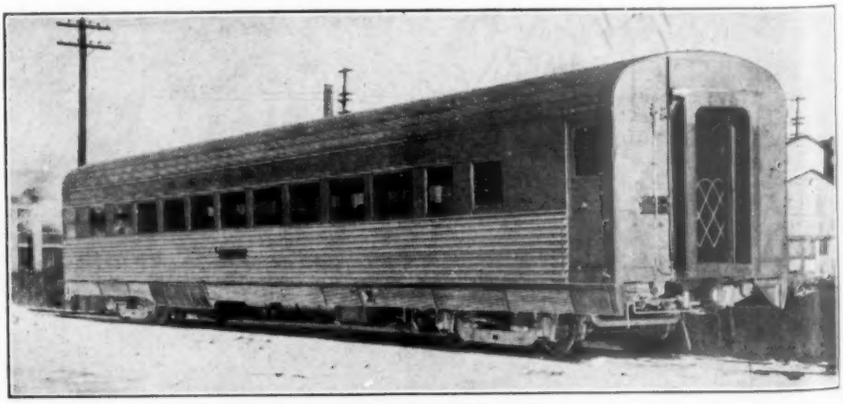
The two bantam-weight cranes are to be used by the Bahrein Petroleum Co., Ltd., a subsidiary of the Standard Oil Co. of California, which is building a new refinery in the Bahrein Islands, between Persia and Arabia. They will see their first service in erecting oil tanks.

Stainless Steel May Solve Railways' Passenger Problem

Lighter but stronger equipment, built of stainless steel to new designs by the "shotweld" process, will answer the railroads' future problems of passenger traffic, according to W. F. Detwiler, executive vice-president of the Allegheny Steel Co., Brackenridge, Pa. Mr. Detwiler made the comment in connection with the new de luxe day-coach which the Edward C. Budd Manufacturing Co. have just delivered to the Atchison, Topeka & Santa Fe Railroad.

A large amount of Allegheny steel, fabricated by the builders' own processes and designs, is contained in this car, which is one-half the weight of a standard Santa Fe coach, although of the same size. The end frames and bolsters are of arc-welded construction. The new coach is the first of its kind and holds forth great possibilities in railroad economies and efficiency. The body is constructed of hollow members, built up from sheets of stainless steel by the "shotweld" process, and covered with panels of the same metal. Although structurally stronger, and therefore safer, this new body weighs only one-quarter as much as a standard body. As the coach will be used with standard cars, it has standard trucks and standard draft gear.

The Budd company recently received orders for four light-weight, stainless-steel trains to be built for the Chicago, Burlington & Quincy Railroad. Two of these trains will have 10 cars each, and the remaining two will be 6-car units. The details of construction will be much the same as that followed in building the famous "Zephyr."



Considerable Welding Was Employed in This Light Weight Coach.

Steel Sheets Protected by Sprayed Zinc Coating

By W. C. REID
Metallizing Engineering Corp., Inc.

Metal spraying solved a perplexing problem for the Dole Refrigerating Co., of 663 W. Washington Blvd., Chicago, Ill., in connection with the manufacture of their vacuum cold plates, consisting of refrigerating coils enclosed in a galvanized sheet-metal casing, in which a partial vacuum is carried. The welding of these galvanized sheets resulted in destroying the galvanizing, making it necessary to apply corrosion-resistant material on and around the welds. The use of black sheet, to be galvanized after assembly, was by no means practical, mainly because the sheets warped very badly during galvanizing, undoubtedly due to stress release.

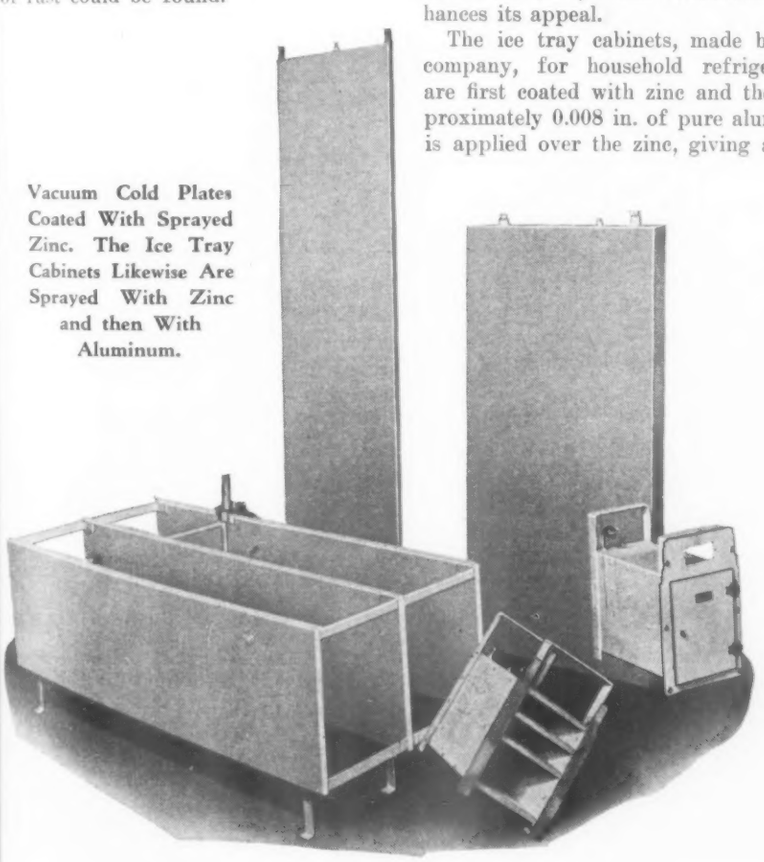
The Dole company had a salt-spray test run on two galvanized sheets, 8 x 5 x 0.062 in., welded at right angles, the weld covered with a "Metallized" coating. The test was made by the Ingersoll Steel & Disc Co., of Chicago. A 15% salt solution was allowed to spray continuously on the sample in an apparatus constructed according to the U. S. Navy specifications. The sample was turned over at the end of 48 hours and again at the end of 72 hours. Inspections of the weld for corrosion were made at periodic intervals. At the end of 98 hours the sample was removed from the salt spray since no evidence of rust could be found.

Spraying Zinc on Plate With Fan-Type Nozzle.

Having satisfied themselves that the use of a sprayed coating was practicable, the Dole company next considered the question of cost, which was estimated at approximately 15 cents per sq. ft., including steel-grit blasting, materials, labor and burden. The company started production on this basis, and the cost has now been revised to where it is less than 10 cents per sq. ft. for the completed job.

The bluish-white matt finish is not only extremely attractive, but it presents an unusual appearance when covered with frost, which considerably enhances its appeal.

The ice tray cabinets, made by this company, for household refrigerators are first coated with zinc and then approximately 0.008 in. of pure aluminum is applied over the zinc, giving a matt aluminum finish that is impervious to corrosion and highly sanitary. Pure virgin tin is also applied to some parts when specified, and in a manner identified with the above, except that the minimum thickness of the tin coat is 0.015 in.



Vacuum Cold Plates Coated With Sprayed Zinc. The Ice Tray Cabinets Likewise Are Sprayed With Zinc and then With Aluminum.

Coming Events

Feb. 27-28. Columbus, Ohio. The Ohio State University. Fifth Annual Welding Conference, including technical program and exhibits. For information write Prof. O. D. Rickly, The Ohio State University. (Program given on page 47.)

Mar. 4. Pittsburgh, Pa. A. S. T. M. Regional Meeting. Symposium on High-Strength Constructional Metals. For information write American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa. (Program given on page 44.)

Mar. 4-7. Minneapolis, Minn., Dunwoody Institute. Welding Confab, by Commercial Gas Co. Demonstrations and exhibits. (See item on page 50.)

Mar. 10-12. Chicago, Ill. National Railway Appliances Association Exhibition. For information write the Association, at 208 S. La Salle, Chicago.

Mar. 11-13. Omaha, Nebr. Welding Confab, by Omaha Welding Co., 1501 Jackson St. Demonstrations and exhibits. (See item on page 52.)

Mar. 12-13. Lawrence, Kan. School of Engineering, University of Kansas. Second Annual Welding Conference, including technical program and exhibits. For information write A. H. Sluss, professor of mechanical engineering, University of Kansas. (Tentative program given on page 25.)

Apr. 20-24. Chicago, Ill. Midwest Engineering Power Exposition. For information write G. E. Pfisterer, 1 N. La Salle St., Chicago.

Apr. 20-25. Houston, Texas. Oil Equipment and Engineering Exposition.

May 4-9. Detroit, Mich. Foundry and Allied Industries Exposition. Also annual convention of American Foundrymen's Association. For information write the Association, at 222 W. Adams St., Chicago, Ill.

May 16-23. Tulsa, Okla. Ninth International Petroleum Exposition and Congress. For information write Wm. B. Way, care of Exposition, Tulsa, Okla.

May 25-27. Philadelphia, Pa., The Bellevue-Stratford. Annual Convention of the Heating, Piping and Air Conditioning Contractors National Association. For information write the Association, at 1250 Sixth Ave., New York City.

June 27-Oct. 4. Cleveland, Ohio. Great Lakes Exposition. For information write Ernest Smith, 3910 Carnegie Ave., Cleveland. (See item on page 44.)

Sept. 22-25. Detroit, Mich. Iron and Steel Exposition. Also annual convention of Association of Iron & Steel Electrical Engineers. For information write the Association, at Pittsburgh, Pa.

Oct. 19-23. Cleveland, Ohio, Public Auditorium. National Metal Congress. Also Fall Meeting of American Welding Society and meetings of American Society for Metals, Wire Association, and others. For information write W. H. Eisenman, 7016 Euclid Ave., Cleveland. (See item on page 25.)

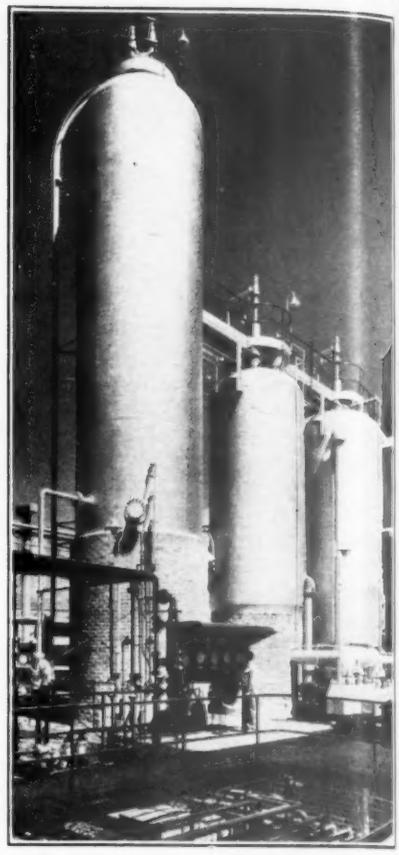
Welding

on display at the

Chemical Show—I

(First of Two Articles)

By ORN T. WEIRS

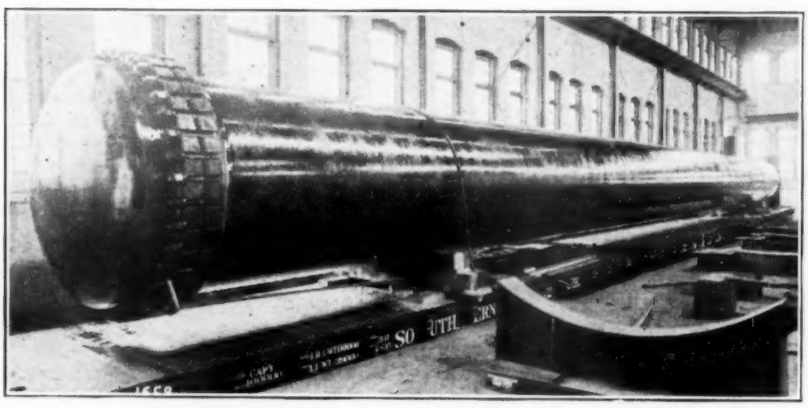


Welded Pressure Vessels of Nickel Steel for Low-Temperature Service.

(Safety is assured through the use of 2½%-nickel steel in these arc-welded dewaxing pressure vessels in the propane de-asphalting unit built for the Union Oil Co., of California, by the A. O. Smith Corp., Milwaukee, Wis. These vessels must withstand shock loads above ordinary operating pressures, and are required for service at temperatures of 50° to 75°F. below zero, at which temperatures ordinary carbon steels lose their toughness. Welding electrodes and coatings were used which introduced nickel into the deposits.)

WELDING is now "going places and seeing things," in company with America's facile test-tube magicians. Of 250 firms exhibiting at the fifteenth biennial Exposition of the Chemical Industries, held in New York City throughout the first week of December, we find that 24 of the most important are now utilizing or specifying welding for a total of 129 items or kinds of equipment. This is really considerably more hopeful and encouraging than it sounds, since not more than 60 of these exhibitors are engaged in handling materials or in making apparatus or machinery for which welding could be used in any way at all. Anyway, it looks as though the field of chemical applications ought to be the welding profession's new "heavy-weight hope"—or rather, in the lingo of the prize ring, "th' new winnah 'n' champ."

Before revealing the reason for thus prophesying, let us first take note that one of the best-known commentators among the chemists, Sidney D. Kirkpatrick, the editor of *"Chem & Met"*, recently summarized a 14 page digest about modern equipments in the process industries with only a single phrase—"stream-lining"—which he explains as connoting "cleaner design, more attention to details, and better engineering." Continuing in further amplification of this statement, he mentions the evidences of standardization, improvements in efficiencies, the neatness of the new machine drives and of the machines themselves, etc., and then climaxes all of his observations with saying—"The phrase, 'stream-lining,' includes the rounding out of better fabrication methods and construction materials, *as witness the virtually complete turn towards welding*, and also the now extensive application of the cheaper but equally useful ply-metals."



Creosoting Chamber, 112 Ft. Long, of Welded Construction.

(This leak-proof cylinder was built by the Combustion Engineering Co., 200 Madison Ave., New York City, for the Southern Wood Preserving Co., of Atlanta, Ga. The shell, which is 8 ft. in diameter, is made of 15/16-in. plate and designed for a working pressure of 250 lb. per sq. in. Similar cylinders have been fabricated up to 130 ft. in length. This is one of 18 different classes of welded equipment manufactured by the Combustion Engineering Co. for chemical-plant applications. This company's Chattanooga plant has one of the largest stress-relieving furnaces in the country, and a 300,000-volt x-ray machine. Now being installed in this plant is a 400,000-volt machine—the highest voltage in this country and capable of penetrating 5½ in.)

We might add parenthetically to the above that welding and the clad-metals (or ply-metals, as some refer to them) are trotting along harmoniously, hand in hand, with revolutionary results as concerns economies and fabrication costs.

Certainly anyone so situated as to be able to profit in any way by welding in connection with chemical applications will be pleased to discover that most of such business is neatly "cut to order," because no other industrial field is more consistently and alertly (we might say cavalierly) "stepping-out" with progress, and, likewise, with everything that is new, and with the process of change generally.

During the hesitant years of 1934-35, American chemists calmly distributed

contracts totalling $35,000,000 worth of new construction for plants in the process industries alone. Moreover, they developed 50 new and important processes, and they made available more than 400 new products and raw materials, including such radical innovations as synthetic soaps and rubber. Practically all these recent developments are now ready for large-scale production considerations. Significant opportunities thereby present themselves to the welding profession, in view of the enormous amount of equipment that will be built. Most of this equipment has to be "tailor-made," so to speak; and from one-half to two-thirds of all of it is necessarily of experimental design, due to the modern tempo of research.

Chemists are evincing a definite preference for welding, and here are their reasons:

12 Reasons for Welded Construction

(1) Welded fabrication is considerably more economical. (2) It is also quicker than by other construction methods, and the attendant results are better, especially for the "tailor-made" classes of equipment. (3) The corrosion problems of riveted lap and butt joints are entirely obviated. (4) Sanitary control is greatly enhanced by the elimination of lap joints and crevices. (5) Welding permits changes in design to be made inexpensively. (6) Apparatus of welded design avoids undesirable excess of weight. (7) Welded constructions withstand vibrations better than do riveted. (8) Changes in standard equipments, to satisfy special requirements, are more promptly and easily effected by a recourse to welding than by any other construction method. (9) Welding eliminates expensive pattern costs, as well as the nuisance of pattern storage. (10) Sharp or uneven edges at the joints, such as constitute a problem in connection with the safe handling of delicate fabrics and many other materials, are easily avoided by using welding. (11) Clearances between welded, moving members of machines may be reduced to the minimum; and welded rotating members are not thrown so much out of balance as with either lap or butt and strap joints. (12) Finally—as concerns that all-important consideration, *sales*—the appearance of welded apparatus is much "smarter" and more modern looking than ever achieved with any other means of fabrication.

Is the chemical business looking up? Are the leading American welders welding their share of it? Ask the Struthers-Wells Co. At this writing they report unfinished orders for more than 400 tons of "Struthers-Weld" equipment to be fabricated of chrome-nickel and chrome-nickel-titanium alloy steel. This includes rotary food cookers, nitriding pots, kettles for acetic-acid service, and all similarly related kinds of apparatus used in applications wherever it is necessary to resist corrosion, or to prevent product discoloration and food contamination.

Corrosion Is Severe in Many Chemical Processes

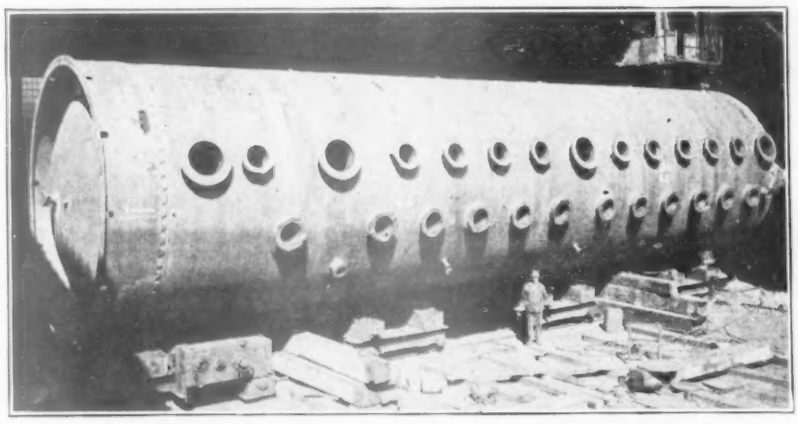
The welding engineer is having to give particular consideration to the persistent destructiveness of the chemists' alleged wily enemy, corrosion. Now, manifestly, corrosion problems might seem to constitute the chemist's most aggravating "headaches"; yet they have also been and still are his obliging benefactors, since they easily outrun obsolescence in reducing chemical equipment to scrap. Accordingly, his "10 above par" advantage over all other engineers is that he has always had a convenient and, in fact, a very adequate excuse for having his equipments constantly rebuilt and redesigned to correspond with all of the currently most profitable trends. Fortunately for many others, this virtue of the scrap-pile has not only been spelling chemical progress, but, incidentally, in a number of different ways it is working for the benefit of the welding profession as well.

For instance, in connection with the above-mentioned factors of change, and also as concerns the challenge of welding to the older forms of structural-steel fabrication, we all know that the principal building steel-work for most of the new chemical plants is still riveted. Of course the details of these new buildings are usually not designed by the chemists themselves, but by outside construction engineers of the old "die-awful-hard school"—our duly respected adversaries who happen to be maintaining the "con" side of the welding-fabrication argument (while inadvertently proving a bewhiskered psychological axiom by personal example; namely: that human nature is the most resistant element to change and progress of anything in the world).

Alterations and Additions Are Largely Welded

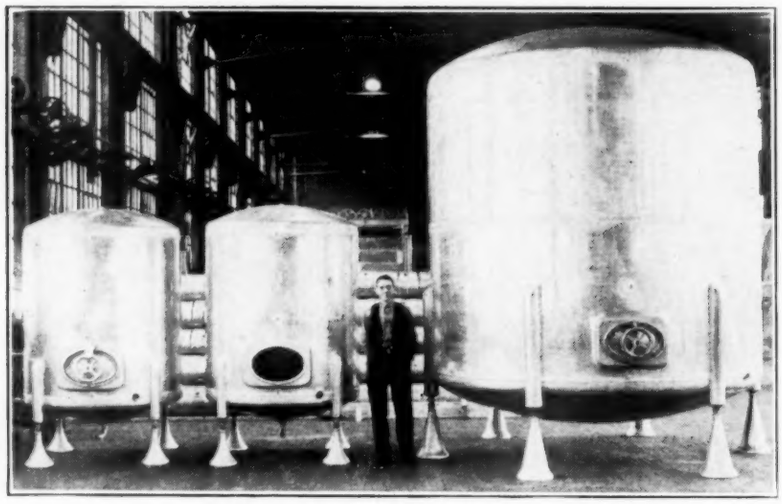
Be that as it may, however, the easily verified facts of today are that welded construction is now generally used for a considerable proportion of all alterations to chemical-plant building steel-work, and for additions thereto, and also for a good deal of the other construction work that occurs inside these buildings—that is, for platforms and mezzanine floors, for frames, trusses and braces, for all sorts of constructions subjected to vibrations and to heavy use (and, more particularly, to abuse), and of course for the supporting structures under machines as well as other equipments which, in many cases, concentrate 50 to 80 ton loads within 100 sq. ft. of floor area. Naturally, the details for all these various items are designed by the chemical-plant engineers themselves; and the actual work is therefore usually fabricated within the shops of these plants, as far as their particular facilities will allow.

In any event, it must be clear that the inevitable result of a good deal of such general experience throughout the country will be in the nature of an ultimately irresistible propaganda, so that now we may almost definitely anticipate the day when some virile chief engineer can say, with an inflexible de-



Crude-Oil Flash Tower, 59 Ft. Long, Entirely Welded.

(This "Masterwelded" flash-tower, made for the Magnolia Petroleum Co., of Beaumont, Tex., by The M. W. Kellogg Co., of Jersey City, N. J., is one of the largest vessels ever shop fabricated for shipment to a distant point. Before it could be removed from the Kellogg company's plant, it was necessary to tear down part of the shop wall and cut away two girders. By special arrangements, it was given a free track on the railroad, with no trains allowed in the opposite direction on adjoining tracks, for the short mileage that was traveled by rail. Further unusual conditions developed when the ship carrying this tower was caught in hurricanes off the Southern coast, but both ship and tower arrived safely at their Texas destination. Each section of the tower is made from a single carbon-steel plate, 1 in. thick, 10 ft. wide and 50½ ft. long, amounting to 505 sq. ft. of surface area, it being the largest plate ever rolled. The unusual size of the heads made it necessary to flange and dish them out of two separate sections, which were then welded together. The completed tower is 16 ft. in diameter, with a length of 59 ft. "on straight", and an overall length of 67 ft. The tower weighs 150 tons.)



All-Welded Aluminum Beer-Storage Tanks.
(These are conventional types of tanks fabricated by the Aluminum Co. of America, at a cost of approximately 50 cents per pound, including the aluminum. As many as 40 such tanks have been supplied for a single installation.)

mand for accomplishment, "Fabricate that new $6,000,000 plant of ours with all-welded construction throughout—every bit of it! We have been using welding wherever possible for 15 years now, and we like it better. Examination of the experience in the entire field of American chemical applications proves that this preference is not only feasible economically, but from any rational and impartial engineering perspective which is of anything at all like honest proportions."

Most of the revelations in engineering history show that it has been only by similarly comparable and usually subtle, yet nevertheless determined, transitions that all great changes and advances have been accomplished. So, as pertains to welding, let us now examine the current evidence of its status as it was featured at this year's "Chem Show," which was attended by 52,200, many of whom were engineers from the metropolitan areas of the East.

Light-Weight Members of Welded Stainless Steel

As one from among the most substantial of the uncracked vertebra still left in our national backbone (after having commendably survived the slump and the torturing thumpings of the political chiropractors), the United States Steel Corp. was alertly "on the job," exhibiting the new spot-welded, stainless-steel lattice beams, and several other built-up and welded train-frame members. These comparatively recent innovations were shown as they were used by the Budd Manufacturing Co. in the construction of the "Zephyr," and for the other stream-lined creations that were so courageously pioneered while a very bilious world was "free-wheeling" over the slippery dumps of the recent depression.

These welded frameworks, about which considerable has already been written, are as interesting to see and study as any Zeppelin or dirigible girders ever were; but has anyone yet asked the question as to what their effect may be upon the future utilization of welding in conventional building steel construction? The stainless-steel in these new trains is good for an ultimate tensile strength approximately three times that of the ordinary structural steels. Now certainly it is obvious that nothing would be gained by this departure from the old-fashioned train designs—"those relics of barbarism," as Frank Sprague, the electrical transportation genius, once put it—if, for instance, the several spot-welds at each of the modern lattice joints developed a strength which was anything inconsistently less than that of the steel itself. For the Deacon's famous "One Hoss Shay," poetically created by Oliver Wendell Holmes with the virtue of equal strength in all of its parts, remains even today as the classical ideal in structural principles, as we find them quite universally respected by the world's somewhat "hardboiled," and generally practical, engineering professions.

Respect for welding among steel-work fabricators and other associated individuals will likely be considerably heightened after these new welded alloy-steel trains have conclusively proved their capacity to stand the bumping and slapping around which have been ever inherent to railroading—besides also surviving the much higher speeds demanded by modern traffic and the proportionately higher stresses such as have never before been written into the daily, year in and year out, routines of the railroads.

In addition to these welded frames, U. S. Steel also illustrated and showed a number of other skillfully welded jobs. These were heat-exchangers, jacketed kettles, stainless-steel screw conveyors, gasoline storage tanks of approximately 24 in. diameter by 30 ft. long (annealed after welding), and several smaller items of welded stainless-steel, such as are now receiving a wide and merited industrial consideration.

Clad Metals Find Many Uses in Industry

While considering materials for which welding represents the accepted or at least the preferred fabricating procedure, reference should also be made to the clad-metal called Ing-A-Clad, a Borg-Warner product manufactured by the Ingersoll Steel & Disc Co. These two firms were represented at the exposition by William B. Kellor, a contributor to *The Welding Engineer*, who is now writing an article for an early issue about the recommended fabrications of stainless-clad steels in connection with their world-wide acceptance for a class of applications which should be of immediate interest to almost every industrial field, and to all welders in particular. Our reference is to the simple welded design that Ing-A-Clad features for inexpensive, corrosive-resistant smoke and vapor stacks. The largest producers of soaps have been using such stacks for some time in most of their plants throughout the world, and, as a result, are reporting appreciable savings in their replacement costs of expensive machinery and equipments, besides also a noticeable reduction in the deterioration of the exposed structural steel of their buildings—especially as concerns the modern steel roof trusses which have so generally displaced the wooden trusses of their grandfathers' stackless factories.

One of the most pestering maintenance problems in all processing plants, for even the smaller establishments, has been the heretofore rapid disintegration of similar stacks generally made out of ordinary 16-gauge materials, averaging 16 in. in diameter, and used to carry off gases which are either corrosive or else injurious to the workmen, or both. But now this difficulty is easily controlled by any metal fabricator—assuming that he is alert enough to utilize the new corrosive-resistant clad-metals in welded constructions.

Clad-metals are finding a place in cookers, milk transportation and storage tanks, chemical evaporators, centrifugal separators, yeast-culture vessels, cheese vats, autoclaves for corrosive materials to be agitated and handled under conditions of elevated temperatures and a certain amount of pressure, and much simpler jobs, such as shower-bath stalls. It should be noted here that the several advantages of perfect sanitation are in-

cidentally associated with the freedom from corrosion which the clad-metals, and the correct techniques of welded construction, now make available for the first time at prices which are economically "down to earth" for the average purchaser of these requirements. Ing-A-Clad, for instance, provides stainless-steel protection at about half the material cost of solid stainless, an economy which was first recognized by those most concerned—the food and chemical industries.

Who can say what effect this realization of available savings will have upon the sales of the glass-lined apparatus that has been so popular in the food, cosmetic, perfume, pharmaceutical and dyestuff industries for more than fifty years? Such occultly delicate predictions will be discreetly left to oracles, while we lean back contentedly in our easy-chair and report, with pleasure, that the Pfaudler Co., the originators and also the world's largest producers of glass-lined steel equipment, are now using welding almost exclusively for all of the permanent metal fabrication involved in the more than three dozen different kinds of apparatus built by them. Bacterial and sanitary control are of fundamentally serious importance wherever such equipment is selected, so that the clean-cut advantages of welded construction over riveted joints is perfectly obvious for such applications as yeast, sugar, fruit and grain fermenters, for pasteurizing and dairy equipment, for blenders, purifiers and stills, and for percolators, bottling tanks, solvent recovery equipment, digesters, evaporating-pans and emulsifiers. Readers will kindly note that this and other similar long lists are not intended to be boring, but only as evidence of the modernly acclaimed virtuosity of welding.

Wide Variety of Applications of Nickel and Its Alloys

As is usual at New York's engineering shows, the International Nickel Co.'s representatives were diligently recruiting new business with interesting illustrations, supplemented by what is best described as their "young technical library" of authoritative and convincing factual information that all experienced practicing engineers have so frequently found both dependable and useful. Applications of International's nickel steels, monel-metal, and their newer nickel-clad metals in outstanding welded constructions were pictured and described as they have been utilized by well-known companies for 15 fundamental kinds or classes of equipment applied to 18 basic industries — including rayon manufacture, petroleum production and refining, paints, varnish and ink manufacture, plastics, soaps and soap products, pulp and paper, and so on—in order either to resist corrosive action or else protect the purity of more than 350 different chemicals and products. Typical examples, usually are welded, are rubber mixers, pressure vessels for propane dewaxing at 70° F. below zero, glycerine and gelatine evaporators, toilet-soap boiling kettles as large as 16 ft. in diameter by 45 ft. high, bubble stills for fatty-acid processing, and enough other items to make up a large-size bulletin.

We get sort of "winded" from just thinking about such popularity and affluence, merited though we know it to be; so please understand and excuse us now for suddenly (and sociably) diverting your thoughts to "suds and likker," especially if no ale is conveniently available where you happen to be at the moment.

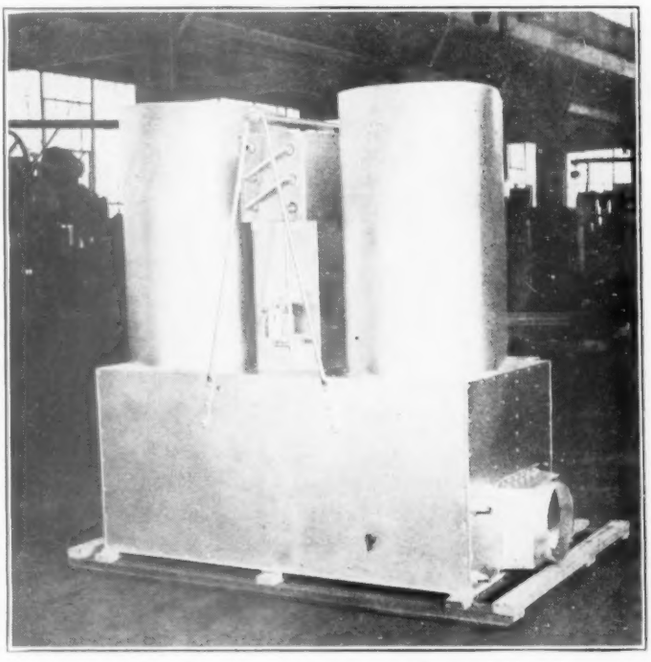
Aluminum Barrels Cost More, But Save in Handling

The facts worthy of being reported are that seven different novel designs of welded steel and aluminum barrels for beer and chemicals were on display. Beer is always an interesting subject, so we stopped to chat with the engineers of the Aluminum Co. of America about their welded beer barrels, as well as about their welded aluminum storage tanks for beverages. Despite the fact that an aluminum "half" costs $10, or 70% more than a standard $6 wooden barrel, evidently recent orders testify to the advantages of the new metal constructions. One brewery on the west coast has 12,000 of them now; a famous Milwaukee brewery recently bought a trial lot of 5,000 "halfs," and an equally well-known Milwaukee competitor has just ordered 15,000. Some of the considerations which influenced these sales and the departure from wood are that the metal barrels never leak at the joints (thanks to welding), they can be more readily sterilized and do not get "sour," shipping costs are lower because of the lighter weight, and life in service is notably increased. An aluminum "half" weighs only 18 lb. as against 75 lb. for a wooden barrel. This makes a very considerable difference to the men who "waltz" them around in transit, since a full aluminum "half" of beer weighs only 148 lb., and can therefore be easily handled by one man who, alone, would find a full wooden "half," weighing 205 lb., quite a "chore" to manage.

The normal drop or fall in handling barrels full of beer is said to be from 12 to 18 in. Thus, aside from the already mentioned advantages of the metal designs, obviously wear and tear are also considerably reduced under the punishments of shock handling, due to both the stronger welded construction and to the considerable reduction in weight.

The Aluminum Co. uses oxyacetylene welding on these barrels, on their storage tanks, and also for food kettles for all of the seams which are to be hammered and ground off, as well as for every joint which comes in contact with the materials being handled, and for certain other joints where "nice appearance" is desired. All other welding is by the electric arc—that is, most of the outside welding, especially as concerns legs and supporting structures.

At this point in our education we had the pleasure to meet an aluminum barrel "in person," only to perceive that there was nothing in it but good design! Our indignant lady friend said, "Fie on the Aluminum Co. They must be from Philadelphia!" Immediately perceiving and heeding certain storm signals, so well known to men throughout the world,



Air-Conditioning Type of Lectrodryer.

(This device, with all-welded internal construction, is furnished to supply large quantities of dehumidified air under conditions of automatic operation. Made by the Pittsburgh Lectrodryer Corp., Pittsburgh, Pa.)

we proceeded at once to circumvent the impending "dunder und blitzen" by wandering over to the booth of the Pittsburgh Lectrodyer Corp., where G. L. Simpson, vice-president and general manager, was manifesting an amiable enthusiasm for welding as his company applies it to their high-pressure vessels, such as adsorber "bottles" for the drying of carbon dioxide, hydrogen, nitrogen, air and oxygen which must be reduced to "bone dry" conditions, with dew points below minus 76° F. Lectrodryers are trim-looking machines designed specifically for dehumidification. Moisture is removed by the physical phenomenon of adsorption by means of activated alumina, a solid adsorbent especially prepared by the Aluminum Co. of America.

One of the novelties of Lectrodryer designs is the use of head bolts which are attached to the cylinders only by welding. This allows the bolts to be placed closer in towards the center than in conventional constructions, which means better spacing for a given head area, and consequently less trouble from leakage, besides also a reduction in the bending stresses. These are problems which always require careful consideration in designs for vessels operating under pressures as high as 3,000 lb. per sq. in. Lectrodryer pressure vessels which have to meet such operating conditions are tested at 6,000 lb. per sq. in., and of course all welds are subjected to either x-ray or gamma-ray tests.

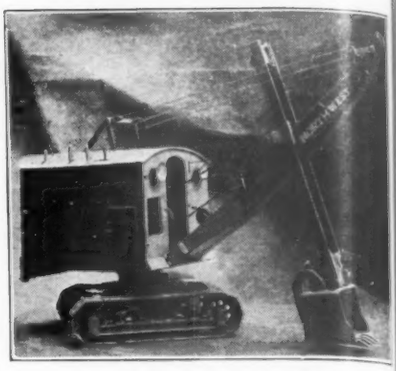
No doubt many welding engineers will sooner or later meet up with this equipment in connection with welded work on air-conditioning installations, especially where lower than normal humidities are required, as in warehouses wherever it is necessary to prevent condensation of moisture upon stored products; or in pharmaceutical houses and chemical plants where hygroscopic salts are handled; and likewise in many other chemical and metallurgical manufacturing processes.

(This article will be concluded in the March issue.)

Working Model of Shovel Built by Welding

A miniature electric powered shovel, measuring 18½ in. from the floor to the top of the cab, and 31 in. long, and weighing 194 lb., was recently constructed by the Kalispell Welding Works, 240 First Ave. West, Kalispell, Mont., according to Alfred Getz, proprietor. Both arc and gas welding were used.

This little model has all the construc-

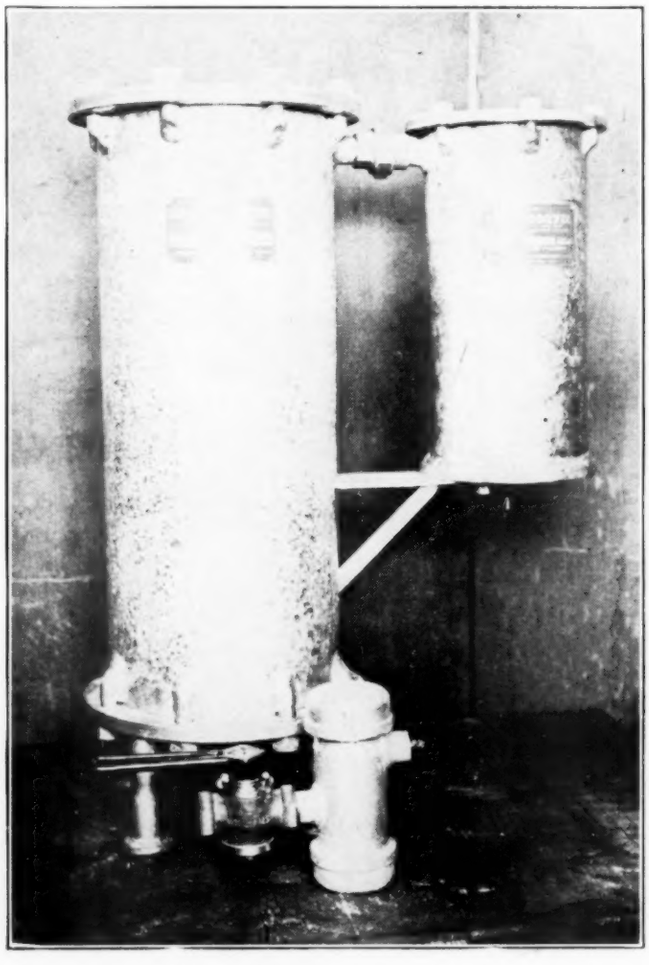


Miniature Electric Shovel.

tional features of a full-sized shovel. It travels backward and forward, and cuts in any direction. Power swings make it full revolving, and a hoist is provided for raising and lowering the boom.

The digging unit consists of a hoist drum which, by means of a line, raises the dipper head ends at the top end of the dipper sticks, thereby providing an automatic crowd. It also has a positive crowd drum, which is reversible, the haul back line being connected to it.

The electric cord is plugged into the travel base, and current is transmitted through the propelling shaft and taken off from the collector rings to the motor.



Dehumidifying Unit With Welded-On Head Bolts.

(Arc-welded, low-pressure, 10-in.-diameter Lectrodryer unit, with a small Lectrofilter ahead of it. Construction is similar for high-pressure applications, except that the bolts are placed closer together.)

Structural Specifications Are Made More Liberal

Restrictions in the use of welding on bridges and other structures are gradually giving way to more liberal specifications, it is pointed out by Albert Reichmann, vice-president, American Bridge Co., Chicago, Ill.

The American Railway Engineering Association Specifications for Steel Railway Bridges, dated 1925, limited the use of welding to the remedying of minor defects. In 1932 Mr. Reichmann, as chairman of a subcommittee of Committee XV on Iron and Steel Structures, A.R.E.A., drafted a tentative specification for Fusion Welding and Gas Cutting for Steel Structures. This specification was submitted to the A.R.E.A. in 1933, and although it has not as yet been adopted as standard, it is being used.

"As a result of restrictions in specifications, there has been very little welding until recently," says Mr. Reichmann. "Welding is now being used very extensively in tank construction and specialties. In recent years, small bridges have been designed and built with welded connections, particularly wide-flange beam bridges. Welding is also being used extensively in reinforcements and repairs to existing bridges; and in many cases pedestals are now made of welded structural shapes which were formerly made of cast steel."

Pittsburgh Brewery Installs 46 Carbon-Arc-Welded Vats

The Pittsburgh Brewing Co. has just completed the installation of 46 carbon-arc butt-welded storage vats in a brewery expansion program at their plant in Pittsburgh, Pa., which involves a total expenditure of approximately $100,000. These welded tanks, which were built by the fabricating division of the Bethlehem Steel Co. at their Leetsdale works, near Pittsburgh, constitutes probably the largest installation of vats since the repeal of prohibition.

Some idea of the magnitude of this huge installation may be had from the accompanying illustration, which shows workmen placing one of the vats in position. President John W. Hubbard, of the Pittsburgh Brewing Co., and his assistant, Harry W. Meyers, personally supervised the installation. In addition, the company also installed two large welded aluminum tanks.

The cylinders of the steel tanks were fabricated from ¼-in. plate, with 5/16-in. heads. Twenty-two of the tanks are 18 ft. long, 16 are 11 ft. 7½ in. long, and 8 are 10 ft. 7½ in. in length. The aluminum tanks are 18 ft. long. All are 7 ft. 7 in. in diameter.

The steel tanks are coated on the inside with mamut, which has a tar insulating base, thus preventing the beer from coming in contact with the steel. The aluminum tanks are not coated on the inside. The exteriors of all the steel tanks are coated with aluminum paint. The total capacity of the 48 tanks is in excess of 7,000 barrels and involved an outlay, for this equipment, of approximately $25,000.

The installation of metal vats in breweries has come about principally since repeal. Although wooden vats have been in use for a long time, steel presents several advantages, and steel construction is undoubtedly cheaper in the long run. Moreover, the steel tanks are not so bulky.

The Pittsburgh Brewing Co. is said to be the largest in the state of Pennsylvania, and demand for the brewery's products has far exceeded the company's most optimistic expectations, according to Mr. Hubbard. In commenting upon the outlook, he said: "We fully expect the summer sales this year to approach pre-prohibition levels."

Welded Metal Vats Are Said to Have Advantages Over Wooden Vats in Brewery Service.

Bicycle Shop Saves Money With a Welder

An item of repair-department equipment which T. W. Murphin, for 28 years a Longmont, Colo., bicycle dealer, is enthusiastic about, is an electric welder. Now he can do repair jobs on broken frames that are highly pleasing to his customers.

"I got the equipment primarily so that I could give better service," Mr. Murphin explained. "Getting my welding done out, I had constant trouble in turning out superior jobs. With welding equipment in my own shop, I save time and cut my costs. It is money-making equipment. Indirectly, it adds to the reputation of my repair shop among the bicycle owners of the town."

Mr. Murphin has been in the bicycle business continually since 1907. Although he actively promotes sales of new bicycles (in 1935, his total volume was as great as in the three previous years), he looks to the repair shop to make him the greatest profit.

Welded Plates and Angles Protect Masonry Columns

The use of cover plates, with angles welded at the corners, offers adequate protection to masonry columns, against traffic hazards. In the rear of a building at 712 S. Federal St., Chicago, steel plates and corner angles were welded around the bottom of masonry columns about 10 years ago, by J. M. Jardine, of the Western Welding & Boiler Repairing Co., of Chicago. A recent inspection revealed that the columns are still in good condition, and the plates and angles show no evidence of wear and tear, though, being close to a loading platform, they are frequently bumped or side-swiped by trucks and wagons.

View of Welded Column Sleeve After Ten Years of Hard Knocks.

Before the use of welding, the plates and corner angles were riveted together, and the traffic would catch the edge of an angle leg and distort the angle and sometimes shear the rivets. Replacement of angles were frequent. Welding made a permanent job that has needed no repairs in ten years, and appears to be good indefinitely.

Contracts Awarded for Welded Pipelines

A contract for electric welding 50 miles of 12-in. oil pipeline in Missouri for the Stanolind Pipe Line Co. has been awarded H. C. Price, Inc., the general contractors being the Sheehan Brothers Pipe Line Construction Co. Contracts have also been awarded by the Continental Oil Co. for 44 miles of 6-in. and 44 miles of 8-in. line, both to be laid in the same ditch, from Lake Charles to Basile, La. General contractors are the Apex Construction Co. The firing-line welds will be arc welded by H. C. Price, Inc., and the tie-in welds will be gas welded by the Lindeweld process.

The Apex Construction Co. has also been awarded a contract by the Eastern Texas Petroleum Co. to Lindeweld 55 miles of 8-in. pipe from Longview, Texas, to Rodessa, La., it is announced by The Linde Air Products Co., New York, who also state that the Phillips Petroleum Co. has awarded a contract to the White Deere Pipe Line Co. to lay 40 miles of 2½- to 12-in. pipe at Hobbs, N. M., of which 33 miles will be oxy-acetylene welded.

Resistance Welding—II

Theory and Application . .

(Second of a series of articles)

By L. H. FROST

Welding Engineer, The Electric Controller & Mfg. Co.

THESE curves apply to conventional forms of spot welders and not to special forms, such as gun welders and bar welders. The data are based on machines with a 12-in. throat depth and 12-in. electrode arm spacing. For machines having other dimensions, refer to Figs. 7 and 8.

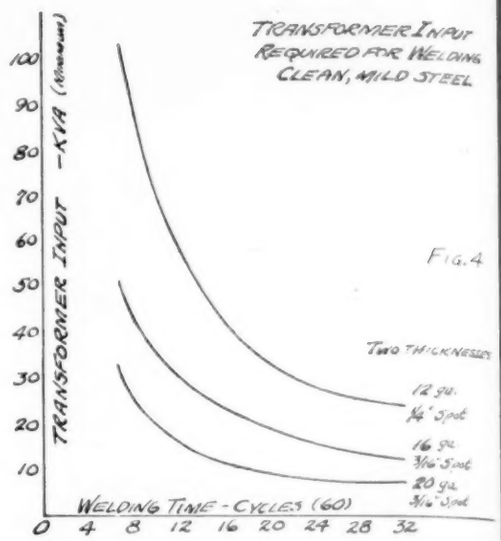

TRANSFORMER INPUT REQUIRED FOR WELDING CLEAN, MILD STEEL
TRANSFORMER INPUT - KVA (Minimum)
WELDING TIME - CYCLES (60)
TWO THICKNESSES
12 ga. 1/4" Spot
16 ga. 3/16" Spot
20 ga. 3/16" Spot
0 4 8 12 16 20 24 28 32
10 20 30 40 50 60 70 80 90 100

FIG. 4

WHEN applying spot welding to any specific problem one must take into consideration the factors discussed in the preceding article*, some of these being as follows: type of material to be welded, electrode pressure, and design of the welding machine itself, all of which have an effect on welding current. This article will deal with the spot welding of steel, and will show the relationships between those factors that have an effect on each other, so one may determine whether any given machine is suitably designed to furnish sufficient capacity for a given job.

Transformer Capacity Required for Specific Job

For determining required transformer capacity, the curves in Fig. 4 are given. These show welding time plotted against power input, or transformer input, for welding clean mild steel of various gauges. The transformer input is given rather than transformer output, because in common measurements of welding-power requirements the input of the transformer is the quantity measured. This input is the product of the actual current required for welding, times the voltage and divided by 1000, which, of course, gives the result in kva. This kva. value does not necessarily apply to the nameplate rating on the welder transformer, since in many cases the welding transformer will actually have a power input greater than the rating. In common practice, with an average length of electrode arms and a reasonably small electrode-arm opening, the power input may be at least double the nameplate rating. In other words, if the nameplate rating of the machine is equal to the required transformer input as shown in Fig. 4, we may be sure that we have sufficient power for welding. This is for the average condition. For the extreme condition of a very wide spacing between the electrode arms and extreme electrode-arm length, more input kva. will be required. From the above, it will be seen that these curves may be readily changed to primary-current values.

In some cases it is desirable to know the secondary-current values, in which case a method now in general practice may be used. This method is to measure the open-circuit secondary voltage; and by dividing the primary voltage (at the time the secondary voltage was measured) by the secondary voltage, a ratio will be obtained. This is the ratio of primary to secondary turns. Multiplying the primary current, when welding, by this ratio gives the value of secondary current. This ratio will vary with the heat taps, so it is necessary to obtain the secondary voltages on all taps. Since these voltages range from 1.5 to 8 volts, it is evident that the ratio between primary voltage and secondary voltage is high, giving a secondary-current value many times that of the primary.

Electrode Pressure for Welding Various Gauges

Another important factor, as previously shown, is the amount of pressure with which the electrodes force the pieces to be welded into contact. The curve of pressure required for welding various gauges when operating at various welding times is shown in Fig. 5, which curve is intended for use in conjunction with Fig. 4. It will be noted that the required pressure increases with shorter welding time, and this is owing to greater pressure being re-

*"Resistance Welding—I," by L. H. Frost, *The Welding Engineer*, Jan., 1936, p. 44.

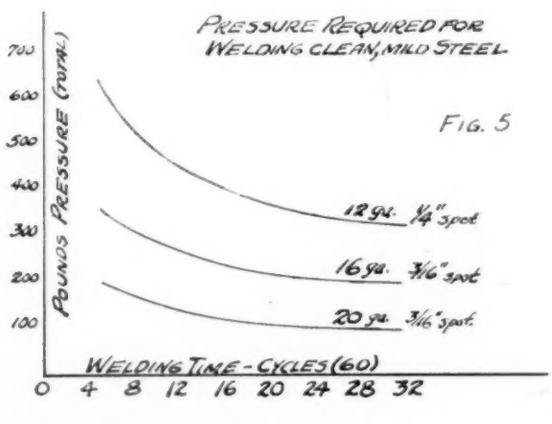

PRESSURE REQUIRED FOR WELDING CLEAN, MILD STEEL
POUNDS PRESSURE (TOTAL)
WELDING TIME - CYCLES (60)
12 ga. 1/4" spot
16 ga. 3/16" spot
20 ga. 3/16" spot
0 4 8 12 16 20 24 28 32
100 200 300 400 500 600 700

FIG. 5

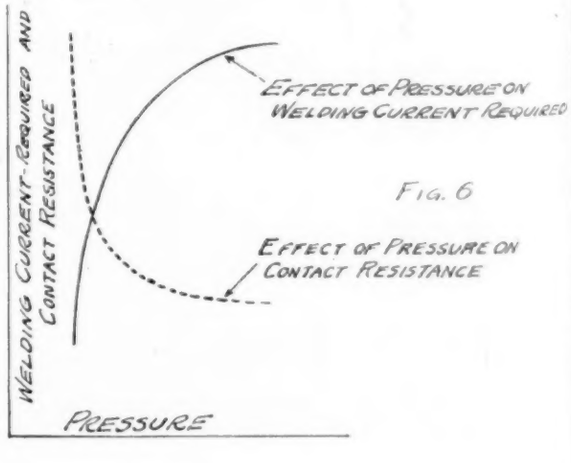
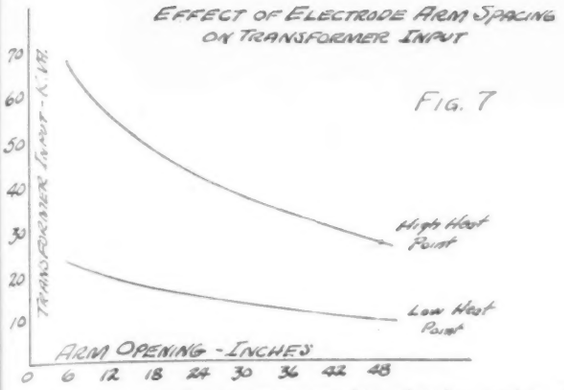
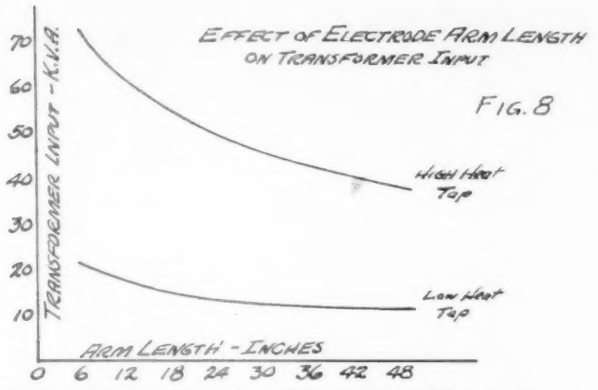

WELDING CURRENT-REQUIRED AND CONTACT RESISTANCE
EFFECT OF PRESSURE ON WELDING CURRENT REQUIRED
EFFECT OF PRESSURE ON CONTACT RESISTANCE
PRESSURE

FIG. 6





(These curves are for an average machine of 25-kva. rating, with 12-in. electrode arm length and opening. They may be used for any average welder by obtaining the ratio between the present and proposed position on the curves and applying this ratio to the existing machine kva. input.)

quired for forging the work together in the short time interval. As the time increases, a greater portion of the metal becomes softer, hence less pressure is required for forging while welding. Also, the higher pressure prevents flashing or burning of the welds due to the high current required. Higher current is required for short-time welding than for long-time welding because more heat is required to raise the metals to a given temperature in a shorter time.

For the curves shown in Figs. 4 and 5, the size of the spot is given. If larger spots are required, more power will, of course, be required as well as more pressure. The spot sizes given are those in average use. Pressure, it will be noted, is the total pressure and not the pressure per square inch.

One of the curves in Fig. 6 shows the effect of pressure on contact resistance. It is the contact resistance which supplies the necessary concentration of heat for welding, which fact was brought out in the previous discussion of thermal gradients (refer to Fig. 3). This curve in Fig. 6 shows the effect of pressure on contact resistance. Actual values are not given since these vary for all types of metals and alloys. The shape of the curve, however, remains the same for all conditions.

The other curve in Fig. 6 shows the effect of pressure on the welding current required. The curve, in this case, gives the change in current required to maintain a uniform heat input with a change in pressure, and does not indicate the change in current that would automatically ensue from a change in pressure. This curve, likewise, is given without actual values, since it varies for every alloy and metal. This is at variance with the curves of Figs. 4 and 5, which are sufficiently general in nature to cover a rather wide range of mild steel.

These two curves in Fig. 6 show how important it is to control the pressure within as close limits as practicable, because a small variation in pressure may mean a considerable change in the current required. This is not so evident when welding steel in long-time intervals, but does become important when welding at short-time intervals and with alloys.

Means for Measuring Electrode Pressure

Electrode pressure is of such importance that it is worthy of further discussion as to means of its measurement or determination. In the previous discussion, a type of pressure meter was referred to which is now available for general use, and this, of course, gives a ready means of determining the actual pressure. In those cases where the meter is not available, suitable means can usually be found for determining this pressure by measuring the ratio of levers or by suitably calibrating springs.

With the manually operated machine the foot lever and upper electrode arm are hinged, and it is possible to measure these lever arms and calculate the ratio of these levers. Then by using a known weight on the foot pedal, it is possible to determine the pressure on the work. This will be approximate only because of friction in the lever hinges. By calibrating the spring, it is also possible to determine the pressure, which would be the product of the compression of the spring in pounds, times the lever-arm ratio between the spring and the electrode.

In the case of the air-operated machine, it is only necessary to read a pressure gauge and multiply by the area of the piston in square inches to obtain the total pressure. Many motor-driven machines have a suitably calibrated spring adjustment, and in others it is possible to use the method given above for manual machines. Most motor-driven machines are cam operated, though some are operated by a crank or eccentric. In machines of the latter type, the motion of the crank is used to move the electrodes together and compress a spring, applying pressure. Since the movement of the crank is always increasing or decreasing the pressure on the work, this cannot be made uniform. Further, after a period of use, the gears and bearings become worn and it is possible to have pressure on the work for only a short period of the complete welding operation. In some cases it requires very careful adjustment of these machines to get satisfactory results.

The curves in Figs. 4 and 5 give the necessary information to determine how much transformer input is required to weld two thicknesses of a given gauge of mild steel, and also the proper pressure for welding. From these curves it should be easy to determine whether existing machines have sufficient capacity for the work planned. As previously stated, the heat developed is the product of the square of the current, times the resistance, times the time, times the necessary constants required to cover varying conditions of electrode shape, conductivity of metals, etc. All these factors are included in the above curves.

Current Affected by Spacing and Length of Electrode Arm

However, the transformer-input kva. curves (Fig. 4) are given only for machines in general use and having a throat depth of 12 in. In case the electrode arms are longer than this value, the welder will develop somewhat less welding current and require a correspondingly less power input. This is also the case for electrodes having a large spacing between arms. Since less welding current is developed and less transformer-input kva. is required, the machine will not be able to weld under the same conditions as with short, close arms, and will be, in effect, the same as a machine of smaller capacity.

Also, the curves in Fig. 4 are for an arm opening of 12 in. as well as an arm length of 12 in. The effect of greater electrode arm spacing and greater electrode arm length are shown in Figs. 7 and 8, respectively. These curves are for an average machine of 25-kva. rating with 12-in. electrode arm length and opening. They may be used for any average welder by obtaining the ratio between the present and proposed

position on the curves in Figs. 7 and 8 and applying this ratio to the existing machine kva. input. The best method is to measure this input instead of using the nameplate rating, since this may not be correct, as previously pointed out.

Problems Encountered When Welding Scaly Stock

For welding scaly stock, some precautions must be taken. In general, this requires either an increase in pressure or a decrease in current, or a combination of both. In the case of scaly stock the resistance between the surfaces and contact is greater than for clean steel, which results in high heat being produced at these points when current flows. In some cases, however, the scale is so tough and thick that current will not flow through the stock without increasing the pressure sufficiently to force the surfaces into intimate contact. In this case, by increasing the pressure above the optimum value, it will also be necessary to increase the current in spite of the increased resistance afforded by the scale. If too low a pressure is used, heat will be developed rapidly; and the force being sufficient to forge the pieces together, flashing will occur and the weld will be very porous in nature. Further, this flashing will cause rapid deterioration of the electrodes. There is no sure method available, nor definite data, on the welding of scaly stock, principally because the thickness of the scale and its nature vary greatly on different classes and types of steel. Thus, some experimentation is necessary when setting up for welding scaly material.

The most common form of electrode in use at present is the copper or copper-alloy electrode in the shape of a truncated cone (see Fig. 3). All curves shown in Figs. 4 to 8 are for this shape of electrode. In some cases it is desirable to use the dome or ball-end electrode, which is of advantage in welding scaly stock. These electrodes, however, are more difficult to maintain unless made from the hard copper alloys.

To prevent mar on either of the two surfaces, a large flat electrode may be used on that side. This electrode, in general, requires more transformer input, due to the spreading action of the current in passing through the work. The increase in kva. depends upon the thickness of the work and usually will not be more than 10% or 15%.

As shown above, there are many factors entering into the welding of steel. Dirty or rusty or scaly materials are mainly responsible for variable results, because of the uncertainty of controlling surface conditions. If clean stock is used, there should be no difficulty in determining what is best for a given job.

Get "H. O. T." on Welding

By H. O. T. RIDLON

Protect Your Acetylene Generator Against Cold Weather

I've been told that we have been having some right cold weather. Personally I've run into some twenty and twenty-five below, but no fifty or sixty below, so I have nothing to complain about I suppose. And from some of the welding shops I've been in these past few weeks, I take it that some other folks have sort of felt the bad weather too. In fact I've had a lot of questions put to me about how to keep acetylene generators from freezing up. And I've found a number of my friends have stopped using their acetylene generators during the winter months for this reason. Result, that the bottled-gas manufacturers have been getting a break.

Jimmie Pool, who owns the Louisville Welding Works, in Louisville, has about the smartest arrangement that I've seen in many a day, to keep his generator house warm in the winter so that his acetylene generator will not freeze. He has very generously given me the layout and his permission to print it.

I think that the drawing gives you all the details you need to build one for yourself. Of course it is all welded and can be made from scrap found in most any welding shop. Or the local junk yard.

As you see there is no flame of any kind in your generator house because it is run by a small gas heater in the shop. But, you have no gas in your shop, or even your town, so you can't work this swell idea? Don't let that bother you, Me Hearty, because you can work it from a bottle of propane gas, which is known under a number of trade names such as Shelgas, Philgas, Hopane, Skelgas and so on almost without end. But after all, it is all propane. This is a very hot gas and a little goes a long way. Many of you country shop owners may use this gas in your own homes for cooking. It is a simple thing to adjust an ordinary gas burner to suit this gas.

If some of you shop owners happen to try this propane, you may also wonder if it can be used for preheating and annealing. Well my friends it sure can, and works swell. Some years ago Jack Mason, engineer with the American District Steam Co., fixed up a very clever arrangement for annealing arc-welded pipe joints in the field. I believe that it was first used in Lansing, Mich., by him. Of course, that was long ago, before the conventional protected-arc rods were much in use. And as I said, it was done in the field and as I remember it it was a very cold winter.

Oh yes, propane can be used for cutting too, but we won't go into a long discussion on that. Just answering the question should it come to your mind. And most propane cylinders have the conventional P. O. L. cylinder connection.

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The thought for the month: Invest in yourself, it should pay big dividends.

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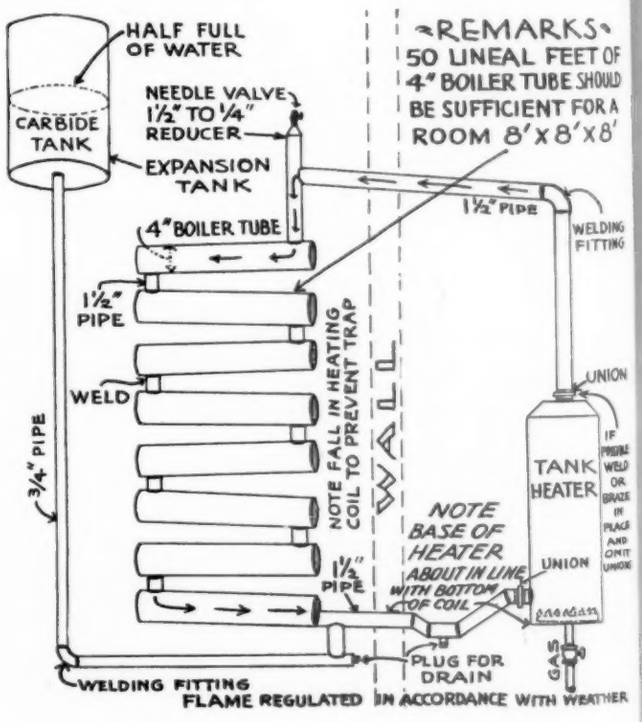
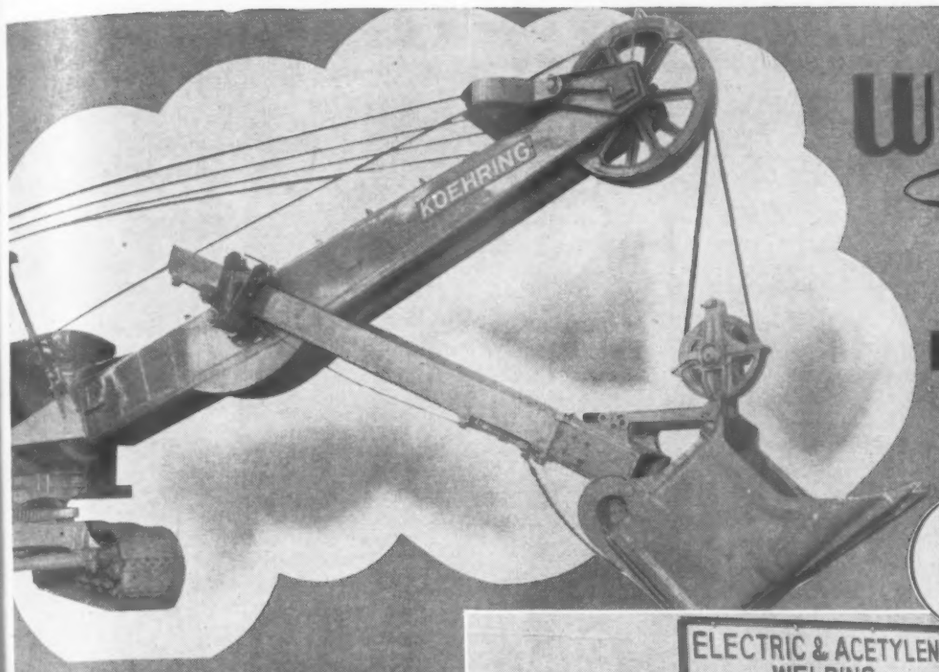


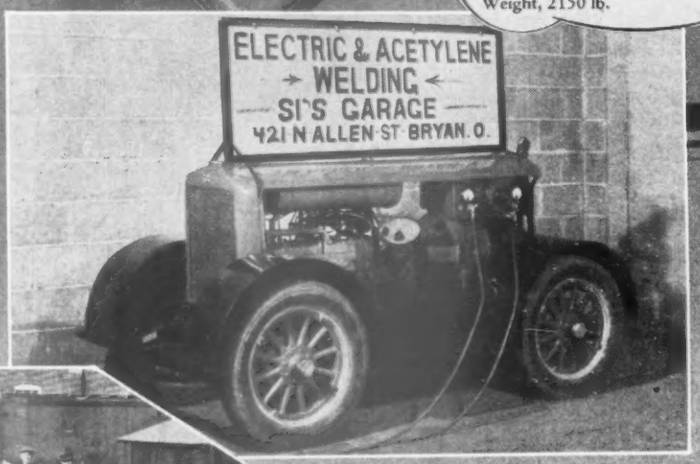
Diagram of Hot-Water Heating System for Keeping Acetylene Generator From Freezing.

WELDING News IN PICTURES



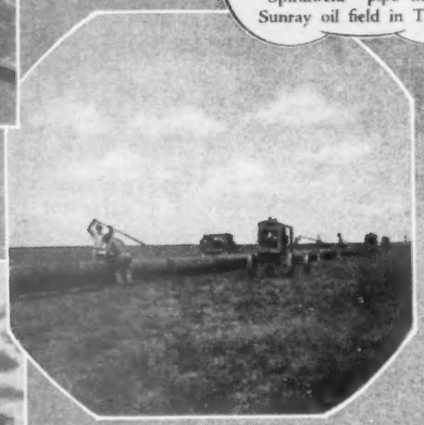
● Time was when a power shovel's beauty resided almost wholly in its brawn. But this unit, built by the Koehring Co., Milwaukee, Wis., out of arc-welded steel, not only possesses greater strength per pound than brawnier-looking shovels, but has pleasing lines, unbroken by protruding connecting members. (Photograph courtesy of The Lincoln Electric Co.)

● (Below) Demur Siler, Ohio job-shop owner, built this 200-ampere unit from a Model T Ford frame, with 2 Whippet axles, and a 6-cylinder Pontiac engine. Weight, 2150 lb.



● (Above) Over 500 ft. of welding was used in constructing this tank, 60 ft. long, 8 ft. wide and 3 ft. high, built of 3/16-in. plate and 3/16x3-in. angles. Total time, 18 hours, including setting of sheets, tacking and welding. Built by the Moon Welding & Machine Co., Kokomo, Ind., this tank will be used for cooling canned food products after coming from the cooker.

● (Below) On the firing line, laying and welding a 20-mile length of 24-in. "Spiralweld" pipe in the Sunray oil field in Texas.



● Cutting off the top of piles preparatory to welding on steel plates, in the construction of a bridge near Columbus, Nebr. This is one of 18 such projects handled by the Economy Welding Service, Omaha, Nebr.

Mostly About People

Intimate Items Recorded by "TROPEL"

Eliminating Competition

One of the mysteries of the trade has been cleared up, according to C. J. Holslag, of the Electric Arc Cutting & Welding Co., Newark, N. J. But let him tell the story:

"The other day I was in Cleveland, and having two or three hours before the train went, J. F. Lincoln took me as his guest to a health gymnasium in order to teach me handball, which I had not played since I left college 27 years ago. The gymnasium instructor said I'd better go easy—but not for me! I got right into the game with Mr. Lincoln, and another man just about his size, and the Pro. Of course, I was stiff and clumsy, and even the Pro and I couldn't stand up against the other two.

"But to get to the point of the story, a hard rubber ball in a small closed room, bounding off the ceiling and side walls and back walls, is liable to catch you in a lot of vulnerable spots, and the wild swings and contortions you get into after not having tackled such exercise for 27 years bring some shrieks from your muscles the next day, despite the steam room and the rub-down. The next day I was not much good. My right arm was so sore I had to use my left arm to hold it up. I could use my right wrist a little, but this was not much good because my hand was so puffed up from hitting the ball that I couldn't grasp anything.

"I came home on the sleeper. The only way I could get up was to roll over out into the aisle. To get into my clothes, I had to lay them down on the berth and crawl into them. In the diner, the waiter, who was an observing chap, remarked, 'We have a lot of southpaws that travel on this train.'

"Now, I appear to have entirely recovered, but I can understand how a person of lesser physique would succumb to such Lincolnese treatment. I'm reminded that several welding firms have disappeared from active competition, and I have my own idea of how this occurred."

Scotty Gets a Hair Cut

Scotty "Oil" Garcelon, salesman in the Signal Hill oil field in southern California, went the young lady one better who recently had her hat metal-sprayed with aluminum. During one of the Airco shows in the Los Angeles district, Scotty had the MetaLayeR demonstrator spray his bald head with zinc. The zinc layer came off the top of his head, due, so metal-spraying experts will tell you, to the fact that the surface wasn't properly prepared beforehand by sand-blasting; but around the edges, where a little hair is evident on Scotty's head, the zinc stuck. Since no one wanted to ruin their good scissors on the job, Scotty had to wait until his hair grew long enough so the scissors could be slipped under the zinc and the hair and metal snipped off.

No More Axes for Him

Art Walle, of The Buckeye Boiler Co., Dayton, Ohio, is a good welder, but tempering metal is something else. Art recently took an axe belonging to a friend in to work with him, to temper the blade. After Art had completed the job, the friend found the blade so brittle it chipped off at the slightest excuse. So Art took it back. The second time the same result was apparent. The third time Art wanted to make sure of good results so he went the limit. This time, net results were such that after two licks at a piece of wood, the edge turned over. Art gave up. He says he'll stick to welding and leave tempering alone.

Still Learning

Basil Osmin, polished young welding demonstrator from St. Louis, Mo., has gone in for more schooling. He has enrolled as a student in the Missouri School of Mines, at Rolla, Mo., where he is studying alloy metallurgy, metallography and physical metallurgy under Prof. Chas. Y. Clayton. He finishes his studies in June. Mr. Osmin has already had crammed into him more education than the ordinary man would ever think of using, and he is an able reader and translator of several languages, including Russian.

She Earns Her Spurs

In attendance at the recent Iowa State College Welding Conference was Miss Shirley McMillen, a welder (or weldress), daughter of W. G. McMillen, proprietor of the McMillen Machine Shop, of Clarion, Iowa. While Miss McMillen would not boast of her ability, it was reliably learned that she is actually an operator of both oxyacetylene and electric-arc welding equipment. Her specialty is building welded frames out of gas pipe.

Small Welded Oil Tanks of Simple Construction

By H. B. MORRIS

Because fuel gas is so expensive in our community, located in southern Oregon, many oil-burning stoves and furnaces are being installed in homes and stores. The most popular storage tank for oil is a square one 4x4x2 ft., holding 250 gallons. A customer puts 200 gallons of oil into one of these tanks at a time and saves $1.50 on the price, which is $14 for this amount.

During the past few months we have built 35 of these tanks, which we sell for $17, fitted with a 1½-in. intake plug, ⅜-in. outlet pipe and ⅜-in. air valve with return bend, near the intake. The location of openings is specified by the customer.

We use blue-enameled 20-gauge sheet-iron, cutting one piece 4x10 ft. and another 2x12 ft. These are bent U-shaped, with fairly sharp corners, one U being 4 ft. high and 2 ft. wide, made of 4-ft. material; the other, 4 ft. high and 4 ft. wide, made of 2-ft. material. When the latter is turned upside down the two pieces fit together, making a completely enclosed tank.

A ½-in. strip along the edges of the narrow piece is turned out at right angles to lap against the edges of the wide piece. A bead made with an electric welder fastens the two edges together. After the tank is finished, it is given a coat of galvanized paint.

We also make round tanks holding 450 to 600 gallons, using 12- and 14-gauge iron. We first construct two cylinders, lapping the edges ½ in. and are welding the seam on both sides. Next, the two heads are cut, crimped and welded into place. The diameter of each end disc is one inch greater than that of the cylinder, to allow for a ½-in. flange along the edge of the head.

The discs are crimped with a piece of strap-iron which extends out radially from a ½-in. bolt in the center of the disc. The strap-iron has a right-angle bend near its outer end. The bolt is reinforced with a small metal plate on both sides of the sheet-iron disc. The disc is laid over a block of wood with a square edge ½ in. inside the disc's edge and the latter turned down by pounding the bent end of the strap-iron over it. It is necessary to go around the disc several times, hammering the edge down gradually.

One of the two cylinders is made slightly smaller, so it will fit inside the other one. The discs are inserted in the ends of the cylinders with the flange outward, then hammered down until the edge of the flange is even with the end of the cylinder. The edges are then welded together.

Demonstrations at Heating and Ventilating Show

Among the exhibits and demonstrations at the International Heating and Ventilating Exposition, held at the International Amphitheater, Chicago, the week of Jan. 27th, were demonstrations of welding, brazing and pipe cutting, at the booth of the Air Reduction Sales Co., and demonstrations of soldering of streamline copper pipe fittings by the Streamline Pipe Fitting Co. and the American Radiator Co. Other exhibitors had on display soldered copper pipe fittings. Several concerns also displayed welding fittings for copper, brass and steel pipe.

Comment on 20th Anniversary of "The Welding Engineer"

TWENTY years ago, a smith got busy with prayers, fluxes and special forges, heated, pounded and generally burned up the work—at best a fearful and wonderful undertaking.

The fusion welding I recall was acetylene; a couple of years later, I saw electric arcs at the ship yards during the War.

Only altruistic motives on the part of its editors could ever have produced "The Welding Engineer," as the entire welding fraternity would not have made much of a subscription list.

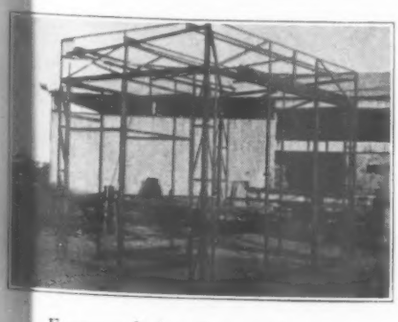
When we now consider what a boon welding has become and recall that welding did not make "The Welding Engineer," but rather, "The Welding Engineer" made welding, let us not forget the debt of gratitude we owe to this splendid publication.

GEORGE T. HORTON, President,
Chicago Bridge & Iron Works.

All-Welded Steel Frames for Filling Stations

Economy and attractiveness, together with fireproof and earthquake-proof features, are some of the points in favor of the all-welded steel frames for filling stations which are being manufactured by the Commercial Welding Co., of Lynwood, Calif.

The frame of the steel room is 9x13 ft. and is 14 ft. high. The material used in its construction is principally 3/16-in. and ¼-in. angle iron, together with T-irons, which are used in connection with the window-sash installations. The frame is entirely shop welded and shop assembled. On completion, it is merely loaded on a large truck and conveyed directly to its location, where three men in about as many hours line it up and install it on its foundation ready for the window glass, doors, and utility connections.



Framework for Service Station.

The job is 100% electric welded, and the manufacturers estimate that by welding, the structure is produced at least 25% cheaper than by riveting or bolting, and furthermore, this type of construction results in a neater, stronger and more durable job.

Notes on Metal Spraying

Applies Wear-Resisting Coating

A metal-spraying job that attracted considerable attention in Milwaukee, Wis., and was featured in a Sunday edition of the *Milwaukee Journal*, concerned a worn cast-iron hydraulic plunger that was metal sprayed by The Metal Spraying Corp., 3610 W. Pierce St., for Cudahy Bros. These plungers, when new, show wear within three months, owing to abrasion by sand carried in the lake water. The wear or scoring runs lengthwise, and, of course, it is impossible to keep the packing tight once the casting starts to wear.

Building Up Cast-Iron Plunger.

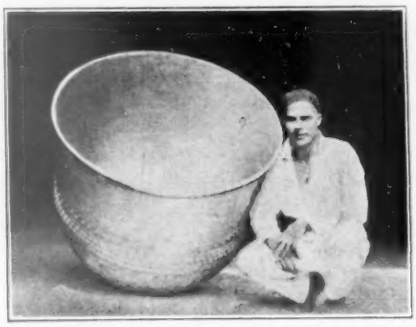
This plunger is 13¼ in. in diameter by 6 ft. 3 in. long, and the diameter was worn undersize at the point of greatest wear. The worn casting first was trued up by taking a cut off the high spots, after which 59 lb. of ⅛-in.-diameter 0.70-carbon steel wire was sprayed on the plunger in 8¾ hours, which is at the rate of 6¾ lb. per hour. The complete job took less than 12 hours for setting up, turning, spraying and take-down, not including the finish grinding.

A plunger similar to this one was built up by metal spraying several months ago, this job also being done by The Metal Spray Corp., and after three months' service it showed no signs of wear.

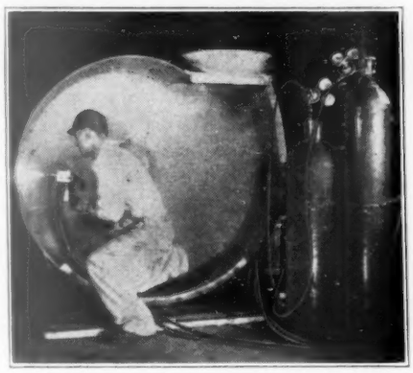
Coats Aluminum With Stainless

The application of hard and high-melting-point metals to metals characterized by low melting points is entirely feasible by metal spraying. An illustration of such an application is cited by W. C. Reid, of the Metallizing Engineering Corp., Inc., 205 W. Wacker Drive, Chicago, Ill., involving the spraying of a 0.025-in. coating of 18-8 stainless steel to the inside of an aluminum kettle.

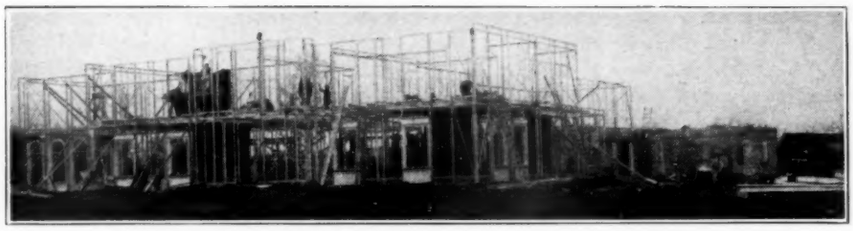
Another job completed by this firm was the lead-lining of a large blower housing to resist severe corrosion due to acidified condensation, though in this case the sprayed metal was of a lower melting point than the plate to which it was applied. In the case of this housing, the fan blades also were sprayed with lead, and it is of interest that seldom is it necessary to do any rebalancing because an experienced operator can work within limits as close as 0.002 in.



Aluminum Kettle Lined With 18-8 Stainless.



Lining Blower Housing With Lead.



Welded Framework of Residence Under Construction.

Welded Frame for Residence Sets Record for Size

"Hearthstone," a home of unusual size now under construction at Ottawa Hills, Ohio, employs the largest welded steel frame ever used in a residence. Walls and floors together use a total of 45 tons of steel, and the application of arc-welding has been so successful that the cost of the completed steel frame was approximately 6% of the total cost of the house, or only 2% more than comparable wood-frame and floor joists. Both shop and field welding was employed, using General Electric arc-welding generators and electrodes.

Architecturally, the house is of Georgian style with a richly textured stone veneer in pleasing contrast with white wood-trim and entrance motif. The home is luxuriously complete in its planning and the building itself is of considerable extent. The plan is L-shaped, each arm of which is over 100 ft. in length.

In designing the structure, architect Myron T. Hill, of Toledo, and structural engineer C. Merrill Barber, of Cleveland, achieved a logical steel frame which is economical, efficient, well-insulated, and free from special patented features and interference with architectural features.

The floors are constructed of 8-in. channels or beams, spaced 3 ft. to 3 ft. 6 in. on centers, covered with a rib lath upon which 2½ in. of concrete is poured. The finish flooring is laid over the concrete. Metal-lath and plaster on the bottom of the floor members furnish the ceilings for the rooms below. Complete floors were poured at first, second and third story levels.

The walls are composed of large shop-welded panels, one story in height, using standard 3-in. channels as studs, and angles, plates, etc., as necessary. All wall panels were detailed to be less than 10 ft. by 18 ft. in size so they could be hauled safely from the assembly shop to the site. The largest panels weigh only 500 lb., so that four men were able to handle the erection with the aid of a small A-frame made of 4-in. timbers.

Bearing plates were set to level on top of the basement wall. First-story panels were placed and temporarily bolted together. First-floor beams and channels were placed; then all first-story steel was aligned and welded. Second-floor beams were placed, wall panels next, and the second story welded. Third-floor beams were placed and welded. Total erection required only ten working days for four structural iron workers and a foreman.

All welding, whether in the shop or in the field, is being done with heavy-coated electrodes. One-quarter-inch fillet welds are used almost entirely.

By the use of girt angles on the inside of the wall frame as support for the floor steel, no interference is encountered in placing pipes, ducts and conduits. The stone veneer is securely fastened to all exterior studs at regular spacings to provide mutual stiffening. Interior studs have horizontal tie-straps.

The use of the all-welded steel frame, together with 5-in. stone veneer, metal-lath and plaster, and air spaces filled with waterproof mineral-wool insulation, thoroughly meets the desire of the owner for a fireproof home with minimum upkeep and elimination of shrinkage and settlement cracks.

Works for Welders' License Law

A law to require the licensing and examining of welders, to insure against the likelihood of poor welding and resulting failures in repair work, is needed in the State of Iowa, according to George Tolman, blacksmith and welding shop operator of Orange City, Iowa.

Mr. Tolman urges that shop owners and welders band together in the Iowa Blacksmiths and Welders Association and work for the adoption of such a law. Those who are interested should write him direct.

100-Day Exposition to Mark Cleveland Centennial

That the steel and iron industry and manufacturers of heavy machinery will play an important part in the Great Lakes Exposition, to be held on the Cleveland lakefront June 27th to October 4th, is indicated in the support given the exposition's $1,000,000 underwriting, by the Republic Steel Corp., U. S. Steel Corp., Standard Tool Co., Cleveland Twist Drill Co., M. S. Hanna Co., Youngstown Sheet & Tube Co., and others.

The Great Lakes Exposition is to be staged on 125 acres of downtown Cleveland lakefront. It is attracting exhi from manufacturers and business con cerns throughout the entire Great La region. The 100-day exposition w celebrate the centennial year of Cle land.

A feature of the exposition will an international village, "Streets of World," occupying ten acres and c taining more than 100 structures.

Coal Company Orders 10 All-Welded Barges

Ten welded steel, standard coal bar are to be built by the Treadwell C struction Co., Midland, Pa., according the terms of a contract awarded them the Pittsburgh Coal Co., of Pittsbu Pa. This contract is one of the lar ever placed in the Pittsburgh dis for floating equipment, and calls for livery during the months of April, M and June.

Preliminary details of the inquiry peared in the January issue of *Welding Engineer*, at which time it hinted that the Pittsburgh Coal leaned toward welded construction preference to riveting.

Some idea of the size of this or which was eagerly sought by a h dozen barge builders, may be ga from the fact that the contract inv approximately 1,500 tons of steel total estimated cost of between $130 and $140,000.

All the barges will be of 1,000 t capacity. The dimensions are unif stood to be 175 ft. in length, 26 ft. width, and 11 ft. in depth. Plates well as shapes will all be welded.

Symposium on High-Streng Constructional Metals

A Symposium on High-Strength C structional Metals will be the techn feature of the 1936 A. S. T. M. Regio Meeting, to be held at Pittsburgh, P March 4th, and during the same w the 1936 Spring Group Meetings A. S. T. M. Committees will be in pr ress in Pittsburgh.

The symposium will comprise t technical papers, as follows:

Morning Session, 9:30 A. M.

"Alloys of Aluminum and Magnesium," E. H. Dix, Jr., chief metallurgist, and J. Bowman, Metallurgical Division, Aluminum search Laboratories, Aluminum Co. of Amer

"Alloys of Copper," by C. H. Davis, me lurgist, The American Brass Co.

"Alloys of Nickel," by F. M. Geiger, Resea and Development Dept., The International Ni Co.

Afternoon Session, 2 P. M.

"Carbon and Low-Alloy Steels," by E. Cone, editor, *Metals and Alloys*.

"Corrosion-Resisting Steels," by E. E. Th editor, *Metal Progress*.

It is intended that the papers d with mechanical and physical propert of the metals and alloys to be discuss Questions of design stresses, constru tional economy, etc. will not be featur

Portraits

By
MILDRED KINKEAD

A Success Story Without a Moral

Early in my husband's business career, a strange happening undoubtedly was a turning-point. Fresh from an Ohio engineering school, he had taken a job of selling motors and arc welders under the wing of A. H. Homrighaus, Detroit district manager, The Lincoln Electric Co.

Mr. Homrighaus is now active in the welding equipment field as proprietor of the Welding Service Co., Toledo, Ohio. Back in 1915, however, he had an influential hand in coaching this young man in the sales and servicing of arc-welding machines and of electric motors.

While he was green and chesty at first, in time the youthful salesman learned the routine of business and began to turn in satisfactory work. About that time he began to feel the need for more money. His beginner's salary had been stretched beyond the elastic limit for some time, and while he continued to live on in frugal comfort at the Y. M. C. A., he had begun to wonder when things would break and yield him a larger income.

At length the break did come, in the form of a telegram from the home office, which arrived one Saturday noon as the office was about to close. "Sales job open. Good salary and bonus. Report Cleveland Monday morning if interested," the message read. Was he interested? He was beside himself. His opportunity had come, but his high hopes struck bottom with a thud a moment later when he recalled the condition stated in the telegram. He had to be in Cleveland Monday morning and he was broke. His laundry had taken his last cent and payday was several days away. Far too independent to think of asking anybody for a loan, he pondered the question of raising the fare to the Ohio city over the week-end. This was before the days of hitch-hiking. Back in 1915, you were prepared to finance your own travels or you stayed at home.

He had almost resigned himself to giving up the new job. He could not see his way out. His parents would have staked him to the money gladly, but his pride would not let him ask. And he would not ask Mr. Homrighaus for a loan. It would have seemed, or so he reasoned, that he could not manage his affairs.

Saturday noon came, and the discouraged young salesman stood lathering his hands in the washroom of the Free Press building which housed the Lincoln company office. Still preoccupied with his problem, he reached absent-mindedly for the roller-towel. The towel was dirty, and he gave the mechanism several hitches, hoping, with an optimism too great for Saturday noon, that a clean place would present itself. The towel kept on going 'round and around, smudged and soiled, when suddenly something fell out of its grimy folds and hit the floor. The shining object bounced into a corner. He picked it up, the thing twinkled in his palm. It was a man's solitaire diamond ring.

The evening papers advertised the ring's loss and the reward offer. The fifty dollars bought the young man a ticket to Cleveland, a suit case, some new shirts and a suit of clothes. He traveled to Cleveland, got the job, made good, and married the girl.

The finding of the ring affected several lives. Mine, for instance.

* * *

Palms Over Miami

Our trip to Florida during the holidays taught us two facts: the ostrich never philanders, and you can get good coffee at only one place in the south.

It was on New Year's day in Jacksonville that we visited the ostrich and alligator farm and learned that the ostrich loves but once. If its mate dies, the bird remains single for life. And had you realized that alligators never get any disease? They are immune to sickness, but they love to fight and are not above nipping off a pal's leg or a piece of his tail in the course of a spat. They live to be several hundred years old; but as they sleep nearly all of the time, longevity does not seem to be of much practical use to an alligator. He has a beautiful pink tongue and he can block his throat with it. By simply contracting his tongue-muscles, he closes off his interior from view entirely, although no one has been able satisfactorily to explain why he needs or wants visceral privacy. The crocodile has a flatter head than the alligator, and he has teeth on the outside of his jaws, instead of on the inside. I cannot think of any conceivable use they could be to him there, but there seems to be nothing rational about either of these sleepy reptiles. An ostrich, too, is an absurd example of design. He trots around on his two-toed feet like a horse, and between those ridiculous feet and his homely little head, there is inserted the silliest body imaginable. Think of the plight of the ostrich—having to balance a two-hundred-pound body on a pair of reedy legs like a crane's. The same Mother Nature who created the beautiful peacock, the swan, and the pheasant, also turned out a job like the ostrich.

Florida travel is heavy this year. The trek of the well-heeled to Miami is in full force. You had better start soon, for the trains and busses are crowded.

There is only one flaw in the South's perfection—and that is bad coffee. We found one place, however, where you can get perfect coffee, the stout brew that northerners like at breakfast, and that is Rector's in St. Augustine. Mr. Patinas, who presides there, is a Greek from the Island of Ithaca. He knows coffee, and when you go there and sip some of the nectar from his Turkish pot, remember to tell him that I sent you.

Florida citrus groves are an excitement to northerners. Southward from Orlando the tawny shade of the oranges deepens to gold. The trees, which are rather small, are heavy with these golden globes. Citrus leaves are glossy, and of a rich, dark green color. To my mind, tangerine trees have all the other citruses beaten from the standpoint of beauty. Their fruit has a reddish tinge; the trees look like Christmas balsams at home, hung with scarlet ornaments.

Although Nature is profligate with beauty in the citrus groves, she does not do especially well by the shade trees in Florida. I cannot share the enthusiasm most northerners feel for the Spanish moss which droops, like long gray whiskers, from many of the trees. Palm trees escape this decoration, which seems rather a pity, for the palm would benefit by having some of its nudity draped. The average northerner, on first seeing a palm tree, is filled with ecstasy. The palm silhouette is different from the trees he is used to, and he mistakes this strangeness for sheer beauty. After a while, he sees that he has been taken in. The exotic glamor of the palm trees had betrayed him into thinking they were beautiful.

Palm trees are both ungainly and impractical. Their trunks are too long for nice proportion, and they do not ward off the Florida sun. No matter how alluring they may look on a resort folder, as shade-providers they are not worth fiddlesticks. Palm trees do nicely as design elements in those wicked Tahiti landscapes, but for shade, give me a maple, an elm, or a 29-cent straw hat.

We did not see a cow anywhere in Florida. I do not know why Bossy cannot live there. You get canned cream with your alleged coffee all over the state. Apples must be shipped in, too. But oh, the pecans. Big as your thumb, with fresh meaty kernels. And we drank mixed citrus juices everywhere, a large paper cup for a dime, and *no sales tax.* (That's my idea of God's country.) At St. Augustine, however, we passed up the fruit beverage to sip a cup of water drawn from Ponce de Leon's Fountain of Youth.

The state of Georgia was a surprise. We'd no idea it was mountainous. The

soil is reddish, and cut by many ravines. For hundreds of miles the railroad runs past tiny farms at the base of steep, rock-faced cliffs. The houses are unpainted, sagging, dilapidated. Scarcely more than sheds, these farmers' dwellings, but each tumble-down cottage has a sturdy brick chimney sending up a steady column of wood smoke. Our fellow-passengers had a good deal to say about these chimneys. "You can't down these people," one old man declared, "they've got a little patch of land and a fire, and by cracky, nothing can harm them much." Another man—a professor, we took him to be—was also an admirer of the pluck of the Georgia farmers. "Those little fires never go out," he said. "They are the southern farmer's defiance to bureaucracy and everything else. Come what may, he can't be beaten."

Meetings of Interest to the Welding Field . .

Ames, Iowa

King Winter landed in Ames, Iowa, on all fours, at the same time as the Eighth Annual Iowa State Welding Conference, and drove the mercury down to 30° below zero, with the result that the conference attendance suffered. In addition to the technical program, many manufacturers held exhibits and demonstrations, and the annual banquet was attended by 128. The banquet program had some interesting talent, and was presided over by Earl Beem, commander of the local American Legion Post.

Chicago

"Welding and Cutting on Railroads," will be the topic of the meeting of the Chicago Section, American Welding Society, to be held Friday evening, Feb. 28th, at 8 p. m. in Mission Hall, Armour Institute of Technology, 33rd and Federal Sts. R. G. Mason, welding foreman, A. T. & S. F. R. R., will preside. Welding operations in railroad shops will be discussed by Otto Gier, superintendent of welding, Grand Trunk Western Railway; and Chas. N. Lammers, supervisor of welding and metallurgical chemist, Chicago & Eastern Illinois Railway, Danville, Ill., will speak on "Reclamation Welding: Its Field, Its Faults." Motion pictures showing welding and cutting operations in some of the large railroad shops will be shown through the courtesy of the Oxweld Railroad Service Co.

Preceding the meeting, Jules Muller will conduct his class in "The Metallurgy of Welding," beginning at 7 o'clock. A dinner will be served at 6 o'clock.

At the meeting of the Section on March 27th, motion pictures on stainless steel will be shown by the Republic Steel Co. The April 24th meeting will be devoted to "Design Standards for Welding," with E. W. P. Smith, of The Lincoln Electric Co., as speaker; and the meeting on May 22nd will be given over to "Weld Testing and Inspection."

The meeting on Jan. 24th, on "Automatic Welding" was presided over by C. Earl Webb, of the American Bridge Co., and speakers were A. M. Candy, of the Hollup Corp., O. A. Bailey, of the Chicago Bridge & Iron Works, and N. G. Copley, formerly of the Norge Corp., Muskegon Heights, Mich., who discussed metallic-arc carbon-arc, and gas welding, respectively.

Detroit

A paper on "Physical Chemistry of Arc Welding" by F. R. Hensel, and a paper on "Fundamentals of Spot Welding" by E. I. Larsen, were given before a joint meeting of the Detroit Section, American Welding Society, and Society of Automotive Engineers, in Detroit, on the evening of Jan. 17th. Dr. Hensel is a consulting engineer with P. R. Mallory & Co., Inc., and Mr. Larsen is a metallurgical engineer with this company.

Los Angeles

In addition to talks by H. U. Baker and E. J. Cipperly on atomic-hydrogen welding, the Jan. 23rd meeting of the Los Angeles Section, American Welding Society, had an unusual feature in the form of reminiscences from some of the "old-timers."

The Nominating Committee brought in their report, and the Committee's slate of officers were elected, as follows: Chairman, J. C. Blake, Victor Welding & Equipment Co.; vice-chairman, Wayne Howard, General Petroleum Corp.; secretary and treasurer, Russell L. Graves, welding inspector, Union Oil Co. Executive Committee: Frank L. Howard, Smith-Emery Co.; R. W. Binder, McClintic Marshall Corp.; B. D. McElfish, welding inspector, Standard Oil Co. of California; G. S. Parsons, The Lincoln Electric Co.; C. P. Sander, Western Pipe & Steel Co.; and F. C. Emery, Air Reduction Sales Co.

Lubbock, Texas

Approximately 260, exclusive of faculty and students, attended the Second Annual Welding Conference of the Texas Technological College, held at Lubbock, Tex., Feb. 13th and 14th. Twenty-three manufacturers and distributors who held exhibits and demonstrations, were entertained at a dinner given by the Lubbock Chamber of Commerce on the night of Feb. 14th, which was featured by a round-table discussion.

Milwaukee

At the meeting of the Milwaukee Section, American Welding Society, held on Jan. 10th, at the Milwaukee School of Engineering, E. L. Quinn, of the American Manganese Steel Co., Chicago Heights, Ill., talked on manganese-steel welding, and the subject of stainless and low-alloy steels was covered by V. W. Whitmer, of the Republic Steel Corp., Massillon, Ohio.

New York

"Low-Alloy High-Tensile Steels" will be the subject of the meeting of the New York Section, American Welding Society, to be held on March 10th in the Engineering Societies Building. At the meeting held on Feb. 4th, Otis E. Hovey, consulting engineer, talked on the subject of "Steel Dams."

Philadelphia

"Welding in a Structural-Steel Plant," the title of a talk by J. A. Mitchell, manager of production, Belmont Iron Works, was scheduled as the feature of the meeting of the Philadelphia Section, American Welding Society, held at 1317 Spruce St., at 8 p. m., Feb. 17th.

Pittsburgh

D. L. Mathias and Charles H. Jennings, welding engineers for the Westinghouse Electric & Manufacturing Company, were recent speakers before engineering groups in Pittsburgh, Pa. Mr. Mathias gave a paper Jan. 23rd on "The Production of Quality Welds" before the American Society of Metals, and Mr. Jennings addressed the American Welding Society on Jan. 15th on "Arc-Welding Procedure Problems."

San Francisco

At a meeting of the San Francisco Section, American Welding Society, held on Jan. 31st, a talk on "The Permanence of Oxyacetylene Welding" was given by Jean LaForce, manager of process service, The Linde Air Products Co., and a talk on "Electric Welding of Copper, Brass and Bronze" was given by C. O. Mansur, of the Eccles & Davies Machinery Co.

St. Louis

A talk on metal spraying was given by R. J. Ryan, vice-president of the John Nooter Boiler Works Co., St. Louis, Mo., before a meeting of the St. Louis Engineers' Club on the evening of Jan. 30th. Lantern slides were used, and examples of sprayed work were exhibited. Souvenir paperweights, made of cast iron sprayed with aluminum, were given away.

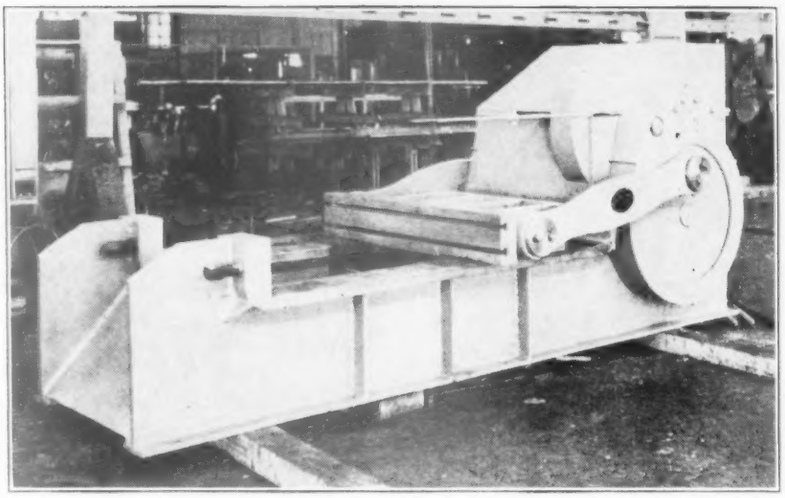
Welded Construction Makes Better Machines

Not to obtain lower costs or more rapid production, but, as a means of assuring a better, sturdier product, the Steelweld Machinery Co., Cleveland, Ohio, has turned to all-welded construction in the bending brakes and bulldozers that it manufactures.

Bending brakes are subject to many kinds of abuse. With older designs, an unnoticed piece of stock in the bottom of a die, or the setting of a ram a little too close, might result at any time in sufficient overload to fracture a housing or to cause misalignment. New parts could not always be obtained quickly, and such mishaps frequently meant a serious loss of time, or a badly disrupted production schedule for the shop using the machine.

While more costly than previous methods, the all-welded construction adopted by the Steelweld Machinery Co. provides brakes that, the manufacturer claims, cannot be damaged by ordinary accidental overloads. Housings, which in previous models had been simple steel plates, are now carefully designed box sections with much deeper throats. Beds, rather than being just slabs of steel, have evolved into heavy I-sections. Crowns, instead of merely taking bearing thrusts, have become integral parts of the beds and give added rigidity to the entire machine. The net result is a monolithic structure that is said to have maximum strength where strength is needed most. Such a structure was impossible to build with castings or with the type of slab steel construction formerly used.

Additional features made possible by redesigning for welding are: (1) deep gaps in the housings to permit the bending of wide plates, even wider than the machine itself; (2) a shallow bed, no deeper than floor level, which eliminates all need for special foundations; and (3) wider housings, providing extra lateral rigidity and preventing deflections. Under excessive overload, allowable deflections culminate rapidly in the motor before becoming great enough to cause a permanent "set" in the members, and a 20% speed loss stops the machine before any damage occurs.

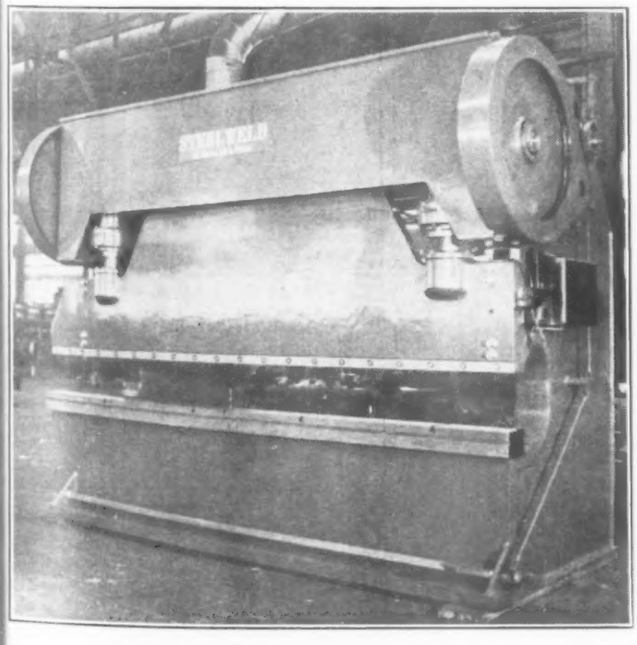


Welded Bulldozer, Illustrating Improved Construction and Appearance.

Similar redesigning of the bulldozers made by this company has resulted not only in additional strength, but also in such improvements as a bronze-bushed roller and ram running in ground-steel ways.

Operators are carefully trained and their work thoroughly inspected. "Murex" electrodes are used throughout.

An unforeseen advantage gained through the new type of construction, says this manufacturer, is a decided improvement in appearance. No conscious effort was made along these lines, but in the placing of the motors inside, out of harm's way, keeping projections and moving shafts away from work and workmen, putting a sturdy crown around eccentrics, and moving flywheels from their usual outside positions to safer mountings inside housings, the natural consequence is a handsome machine whose clean lines convey an impression of ample capacity.



Example of Welded Construction Applied to a Bending Brake.

Program of Ohio University Welding Conference

The Fifth Annual Welding Conference sponsored by the Department of Industrial Engineering of The Ohio State University, Columbus, Ohio, will be held on Feb. 27th and 28th. Manufacturers and distributors of welding equipment and supplies will assist in the holding of demonstrations and exhibits. All meetings will be held in the Industrial Engineering Building. The program, as announced by O. D. Rickly, assistant professor of industrial engineering, is as follows:

Thursday, February 27th

9 a. m. Registration. Exhibits and demonstrations.

1:30 p. m. Technical session.
Address of Welcome, by George W. Rightmire, president, The Ohio State University.
Short talks by E. A. Hitchcock, dean, College of Engineering, and John Younger, chairman, Department of Industrial Engineering.
"Welding Applications Made Possible by the Shielded Arc," by J. F. Lincoln, president, The Lincoln Electric Co.
"Welding of Stainless Steels," by W. S. Walker, The Linde Air Products Co.

7:30 to 10:30 p. m. Exhibits and demonstrations.

Friday, February 28th

9:30 a. m. Technical session.
"Low-Temperature Brazing," by A. W. Swift, service engineer, Handy & Harman.
"A General Discussion of Resistance Welding," by L. H. Frost, welding engineer, The Electric Controller & Manufacturing Co.
"Repairing and Hard-Facing of Agricultural Equipment," by W. A. Moore, Haynes Stellite Co.

1:30 p. m. Technical session.
"Boats Designed for Welding," by R. H. Langdon, Gas Products Co.
"Economics of Oxygen Cutting," by Dr. G. V. Slottman, research department, Air Reduction Sales Co.
"Milestones in Design of Arc Welders," by J. H. Blankenbuehler, Westinghouse Electric & Manufacturing Co.

What's New in Equipment and Supplies

Light-Weight, Spring-Type Electrode Holder

A new spring-type electrode holder, known as the "Simplex," has been announced by The Fibre-Metal Products Co., Chester, Pa.

This holder is especially designed for a.c. welding. It is said to be light in weight, yet sturdy in construction, and has a capacity of 1/16 to ¼-in. electrodes and 300 amperes, which also makes it suitable for use with standard d.c. welding sets.

The jaws are an alloy having a 96% copper content. This insures a high efficiency in the transfer of current from machine to electrode. Insulation of the coil spring is insured by the use of canvas-base bakelite bushing seats—a material which will not char or disintegrate.

The "Simplex" holder is made in two types: one with a soldered connection (Type S) and the other with a positive mechanical or quick-removable connection (Type R).

The mechanical or quick-removable type has the cable connection located ahead of the vulcanized fibre handle, which eliminates the necessity for removing the handle to connect or disconnect the welding cable. The clamp connection is a T-shaped section, which

"Simplex" Electrode Holder.

compresses the cable firmly into the machined U-shaped body of the holder, by means of two ¼-in. screws, one on each side of the center line.

Straight slots as well as angular slots are provided in the jaws so that the electrode can be held at various angles.

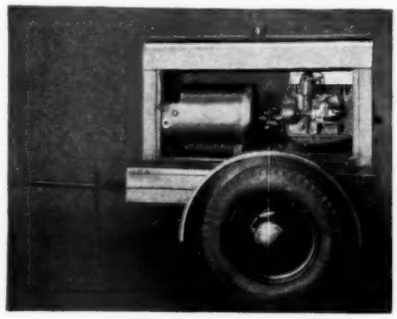
The design of the holder makes it well adapted for overhead welding, the manufacturer claims.

Harnischfeger Announces New General-Utility Welder

A new arc welder of 150-ampere capacity, just announced by the Harnischfeger Corp., of Milwaukee, Wis., is said to have unusually high electrical efficiency, and is powered by a small air-cooled gasoline engine.

Known as the P&H-Hansen Model W-150, this new welder, designed to cover a broad range of welding jobs, uses bare or coated electrodes from 3/32 to 3/16 in. for welding materials of varying thicknesses. Welding is simplified through single current control accomplished by shifting brush holders for current settings over the entire welding range.

For field service, the standard unit can be mounted on a two-wheel highway trailer to travel safely behind an automobile or truck at average motor-car speeds. The trailer is of sturdy, all-welded construction with engine and



150-Ampere Welder on 2-Wheel Trailer.

generator protected from road shocks by automotive-type cantilever springs and balloon tires. Large tool boxes are mounted on each side of the welder for convenience in carrying equipment and accessories. Motor and generator are mounted on a single steel bed plate, making for minimum vibration and proper permanent alignment. The W-150 is also available on a small 4-wheel industrial truck or for factory use with skid mounting.

Electric-motor-equipped models, either stationary or on a 2-wheel truck, are driven through a V-belt drive. Gasoline-motor-equipped units are driven direct-connected at 2200 r.p.m., mounted on a steel base.

The generator is of standard P&H-Hansen design with patented internal stabilizer winding, which provides unusually high arc efficiency without the use of external resistors, reactors or separate stabilizers.

New Electrode Produces Concave Fillet Welds

A new electrode, "Fillet-Craft," has been added by the J. D. Adams Co., Indianapolis, Ind., to their line of mineral shielded electrodes. "Fillet-Craft" is a heavily coated semi-slag shielded electrode, and is to be used with straight polarity.

This electrode produces high-physical-quality fusion metal with quiet, spatter-free arc characteristics, it is claimed, and by its use the operator can produce true-form concave fillet welds of unusually smooth appearance on work that cannot be fully positioned, such as machine bases and structural framework.

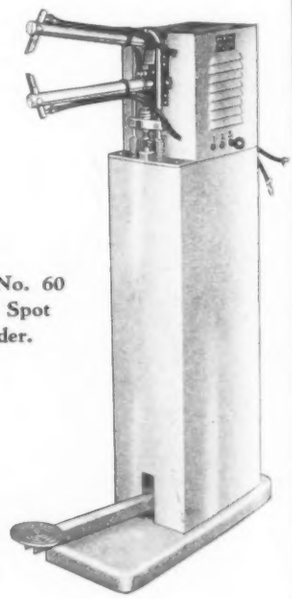
The physical characteristics of the fusion metal produced on numerous test bars have averaged from 80,600 to 82,900 lb. per sq. in. ultimate tensile strength, with 23% to 25% elongation in 2 in.

Spot-Welding Machines for Sheet-Metal Production

A new series of electric spot welders designed to serve the needs of manufacturers of metal products made of steel and steel alloys in ranges from 24 to 14 gauge, have just been announced by the Pier Equipment Manufacturing Co., 1225-30 Milton St., Benton Harbor, Mich. These new welders are not only modernistic in design but incorporate advanced transformer designs, with water-cooling facilities, which are necessary to long life under continuous operation.

The following features are incorporated in these welders: accessibility of all adjustments, which are in front of the welder; automatic trip switch with timing adjustment; welding-pressure adjustment; variable heat control; reversible horns; and the tremendous welding pressure obtained without fatiguing the operator, even though the equipment is used in continuous production.

Through the employment of special transformers, a remarkably large welding capacity is obtained with exceptionally low power ratings. The Model 60 "Ace" spot welder has a capacity for welding in continuous production up to two pieces of 16-gauge steel, while the Model 80 is designed to be used in continuous production for welding two pieces of steel of from 24 to 14 gauge.



Model No. 60 "Ace" Spot Welder.

New 40-Volt Welding Transformers

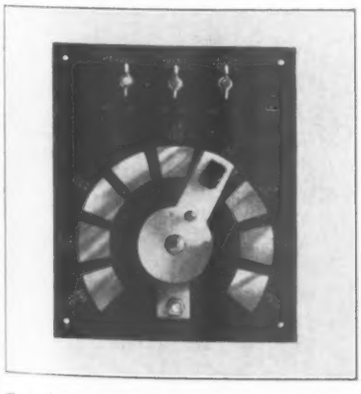
A new 40-volt a.c. welder has been announced by the Wilco Co., 446 State Ave., Kansas City, Kan. This new unit is made in two sizes, the larger (Type L-70) delivering from 50 to 240 amperes and handling 1/6 to ¼-in. electrodes, and the smaller (Type M-40) delivering from 50 to 200 amperes and handling 1/16 to 3/16-in. electrodes. Voltage-control attachment allows a range of approximately 40 to 97 volts open-circuit, and a closed-circuit arc voltage of approximately 20 to 40 volts. The construction of this new welder allows it to be used outside in rainy weather, inside wet boilers, or under other severe conditions of service, with complete safety, it is said. All live terminals are enclosed, and the fiber case completely eliminates any danger of accidental grounding. Voltage and current have independent adjustments, and it is claimed that either remains constant after setting and is not affected by adjustment of the other.

Dial Switch Control for Arc-Welding Units

A dial switch control that simplifies the operation of electric welders, and can be operated without directions, is announced by Miller Electric Mfg. Co., Inc., Appleton, Wis., manufacturers of a.c. welders. Any one able to read figures can operate the welder with absolute safety and efficiency, it is claimed.

This new switch control has the amperage distinctly marked on the switchboard, indicating each step in welding. Setting the dial at the proper figures gives the operator absolute control of the amperage. Its use is said to make the welder easier to operate, and tends to stabilize the arc and prevent sticking.

The control is so designed that it cannot "short" the electrical circuit between contacts. The operator must place the switch dial in the correct position before the welder can be operated, making this an added safety feature.



Switch Control for Electric Welders.

Light-Polarizing Glass Has Many Uses

Polaroid, a light-polarizing glass, that can be used in conjunction with celluloid models to locate and calculate the magnitude of stress concentrations in various types of joints and assemblies, and simplifies the construction of polariscopes used for such a purpose, has been announced by the Land-Wheelwright Laboratories, Inc., 168 Dartmouth St., Boston, Mass. Large quantities of the glass are expected to be used in motor-vehicle headlights and in sunglasses, to eliminate glare, and for three-dimensional movies, complexion analyzers, and other purposes.

At present, Polaroid is available in glass discs approximately 2, 4 and 10 in. in diameter, while sheets are available in unlimited sizes. In substance, it is said to be a suspension of minute artificial crystals in a cellulosic matrix, the

Two Discs of "Polaroid" Can Be Positioned to Cut Out All Light.

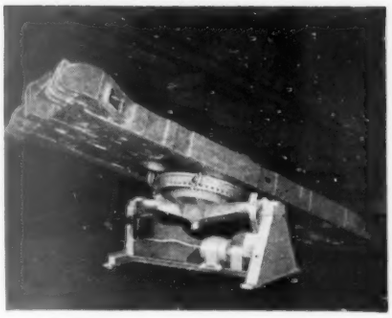
crystals being uniformly oriented and allowing only those light vibrations in a plane parallel to the direction of orientation, to pass completely unabsorbed.

Welding Positioner Has Capacity of Four Tons

The new P-10 welding positioner developed by the Harnischfeger Corp., of Milwaukee, Wis., has a tilting turntable arrangement and handles pieces up to 4 tons, enabling the welding operator to keep work in proper welding position with a minimum of time and effort.

This demand for faster and easier handling comes with the rapidly increasing use of the electric-arc welder as a production tool. Cost studies reveal that where shops are not equipped with proper handling facilities, welding operators are, on an average, spending as high as 75% of their time maneuvering clumsy pieces with less than 25% of their production time actually used in depositing metal.

The new Harnischfeger P-10 welding



Frame on Tilting Turntable.

positioner has a 48-in. revolving table which is manually operated, turns on roller bearings, and is self-locking in 50 positions. The table tilts 90° in one direction and 45° in the other. The tilting mechanism is electric-motor driven through a double-reduction bronze worm gear so that it moves smoothly and can be accurately stopped at any angle with electric push-button control. The motor is supplied for either a.c. or d.c. operation, and is limit-switch controlled. With a 4-ton capacity and a safety factor to carry up to 25% overload, this new unit permits fast handling of pieces of all sizes and shapes to keep work always in an upright welding position for the proper flow of the molten metal.

Phosphor-Bronze Electrode of Shielded-Arc Type

"Aerisweld," a new phosphor-bronze shielded-arc electrode, has just been announced by The Lincoln Electric Co., Cleveland, Ohio. This electrode is said to give a solid, homogeneous deposit, having characteristics of true phosphor bronze with notably high tensile strength. Positive polarity is used.

A few of the many applications include busbars, large contacts, impeller blades in pumps and turbines, ornamental bronze, bronze doors, etc. Many types of bronzes which are exceedingly difficult to braze, are readily welded, it is claimed. The electrode is also valuable for welding galvanized sheets where minimum disturbance of the galvanizing is essential.

In reclamation of worn parts of equipment, "Aerisweld" is used to build up and fill in bronze castings such as journal boxes and containers, for building up bronze valve seats, bronze bearing surfaces on steel or cast iron, guides, etc.

Where heavy bronze or copper is to be welded some preheating may be desirable due to the high heat conductivity of these metals. In such cases, preheating is easily accomplished by using a carbon electrode with negative polarity and rapidly moving the arc over the area to be welded. For cast iron, low current is used, since excessive heat is

detrimental to satisfactory welding of this metal.

"Aerisweld" electrode is made in two sizes, 5/32 and 3/16 in., and 14-in. lengths, and comes packed in standard containers of 5 lb. net each size.

Electrode Deposit Shows High Creep Strength

A series of electrodes for welding the new high-carbon and low-alloy high-tensile-strength steels, that range from 65,000 to 100,000 lb. per sq. in., have been announced by The Champion Rivet Co., Cleveland, Ohio. These electrodes are designated Red Devil-75, Red Devil-85 and Red Devil-95, the numerals indicating in 1,000 lb. the mean tensile strength secured under average conditions.

High physical properties are obtained through the introduction of various ferro-alloys, including a small percentage of molybdenum, which tend to increase the creep strength of the deposited metal.

Among the steels that may be welded with these electrodes are the A.S.T.M. A-149 and A-150 steels, U.S.N. Specifications SGS 118, the 1.5%-nickel 0.50%-chrome series of steel, 2½%-nickel carbon molybdenum steels, and structural silicon steel.

Trade Literature

"The Welding of Enduro Stainless Steel" is the title of a booklet just published by the Republic Steel Corp., Cleveland, Ohio, which discusses the effect of carbon and various metallic elements on physical properties and stability within the critical temperature range, and explains how problems of intergranular precipitation and warpage are solved when welding stainless steel. Arc, gas, atomic-hydrogen, and various resistance methods of welding are described, as well as brazing and silver soldering.

The choosing of the correct glass to obtain protection from glare and injurious light is made easy by means of a table in a folder recently issued by the American Optical Co., Southbridge, Mass., which covers the various kinds of welding and other industrial operations. The folder points out that the degree of protection against injurious rays is not determined by the shade of glass but the chemical content.

The Hi-Cap MetaLayeR, for spraying metals in wire form, is described in two folders recently issued by the Metals Coating Co. of America, 495 North 3rd St., Philadelphia, Pa. File Folder No. 1203 describes the process and illustrates some of the work, while Folder No. 1204 describes accessory equipment such as metal-coating cabinet, blast cleaning cabinet, and blast machines.

The fabrication of Lukens nickel-clad steel is discussed at length in Bulletin T-4, recently published by the Lukens Steel Co., Coatesville, Pa. Details are given for welding by the arc, gas and atomic-hydrogen processes, and information is included on riveted joints, design, surface cleaning, cold working, annealing, physical properties, and standard plate sizes.

"Haynes Stellited Valves" is the title of a new booklet published by the Haynes Stellite Co., Kokomo, Ind., describing many typical applications of hard-facing to the seating surfaces of valves to increase their life under conditions of high temperature or corrosion or other severe service conditions.

A new price list, covering reclaiming units for plow shares and other farm equipments, disc grinders, a.c. welders, cultivator shovels, welding rods and electrodes, accessories, grinding and polishing equipment and hacksaw blades has been issued by the New Process Plow Welding Co., Perry, Iowa.

"Westinghouse Scores Again With the New FlexArc" is the title of a large 11x16½-in. bulletin recently issued by the Westinghouse Electric & Manufacturing Co., Room 5-N, East Pittsburgh, Pa., illustrating this new welder and featuring its radical design and performance.

Industrial applications of paint as part of lighting and "plant conditioning" is told in the new Sherwin-Williams Save-Lite catalog, written for plant men and consultants. Copies can be obtained from the Sherwin-Williams Co., Dept. IMW-10, Cleveland, Ohio.

A sermon on industrial eye protection, forcefully illustrated, emphasizing the expense in the loss or injury of a single eye, is set forth in a bulletin "Eyes—How Much Can You Save on Them?" published by the American Optical Co., Southbridge, Mass.

Opportunities for trained arc welders in industry are set forth in an attractive bulletin entitled "Arc Welding—The Dawn of a Gigantic Industry," issued by the Milwaukee School of Engineering, 1020 N. Broadway, Milwaukee, Wis.

A spot welder, forming press, jig, shear, paint spray table and accessories for sheet-metal work are described and shown in a broadside issued by the Glascock Bros. Manufacturing Co., Muncie, Ind.

A new unit heater for heating the in rush of cold air at large door openings is described in Bulletin D-1, issued by the L. J. Wing Mfg. Co., 14th St. and 7th Ave., New York, N. Y.

A new direct-reading optical pyrometer is described in Catalog No. 70, just issued by The Pyrometer Instrument Co., 103 Lafayette St., New York, N. Y.

How Toncan Iron is used to cut costs in air-conditioning equipment is set forth in a folder issued by the Republic Steel Corp., Cleveland, Ohio.

Commercial News

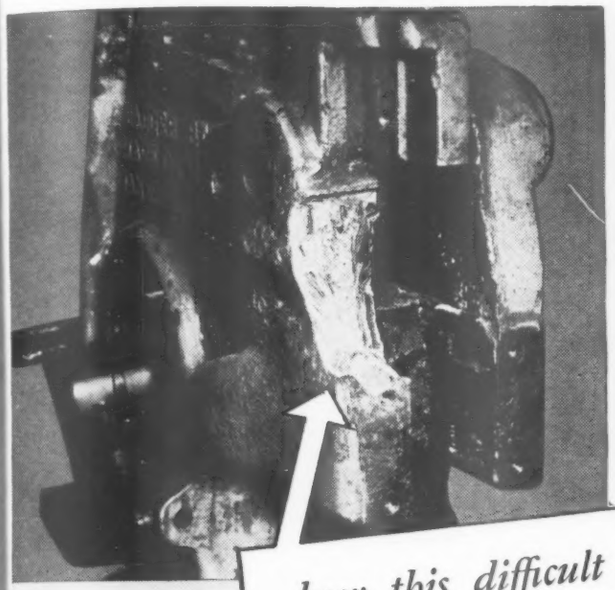
Annual Welding Confab by Commercial Gas Company

The annual "Welding Confab" of the Commercial Gas Co., Minneapolis, Minn., will be held in Dunwoody Institute, March 4th to 7th. A great variety of demonstrations and exhibits are being planned. Concerns cooperating with the Commercial Gas Co. are: Westinghouse Electric & Manufacturing Co., American Arc Welders, General Electric Co., Stulz-Sickles Co., Stoody Co., Crucible Steel Co. of America, Omaha Welding Co., Metallizing Co. of America, Osmundson Spade Manufacturing Co., Smith Welding Equipment Co., F. E. Saterlee Co., Storm Manufacturing Co., and The Black & Decker Manufacturing Co.

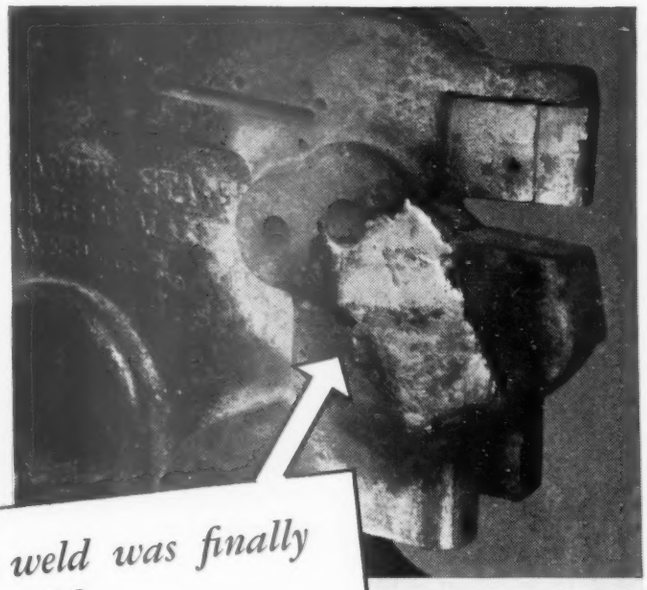
Cuban Distributor Has Welding Exhibit

Welding equipment and supplies were displayed by the firm of H. I. Skilton, Havana, Cuba, distributor for the Harris Calorific Co. and The Lincoln Electric Co., at the First National Congress of Engineering, sponsored by the Cuban Engineering Society, and held in the Society's building, from Dec. 1st to 17th. Following this Congress, the Ninth Annual Conference of Sugar Technicians was held in the same building, and

"It couldn't be done"
...but Tobin Bronze did it



The fractured casting of the shear



The casting AFTER the repair weld had been made with Tobin Bronze

how this difficult weld was finally made with

TOBIN BRONZE

A WELDING firm was given the job of repairing the fracture illustrated above in a casting of a shear 3" thick. It was planned to make the repair weld with cast iron rods. However, detailed inspection of the job revealed that, if this method were used, the size and weight of the shear would make it necessary to heat the entire casting in a furnace to avoid uneven strains in the metal.

This was given up as impractical because, after being preheated, the casting would have thrown off so much heat that no one could get close enough to work on it. In desperation, the shop owner called upon a rival company which specializes in Tobin Bronze welding.

The repair weld was made in 3½ man-hours, including an hour's time required by one man to clean up the weld area with a chisel. The weld area was preheated with one torch while the welder deposited Tobin Bronze with another. The two men spent 1¼ hours on this work.

This is just another case where Tobin Bronze did an otherwise impossible job, thereby saving the cost of a new casting.

• • •

Time-tried Tobin Bronze carries the trade-mark "Tobin Bronze Reg. U. S. Pat. Off." on each rod. Look for this mark and be sure you are getting the genuine product . . . *genuine* Tobin Bronze. 36294

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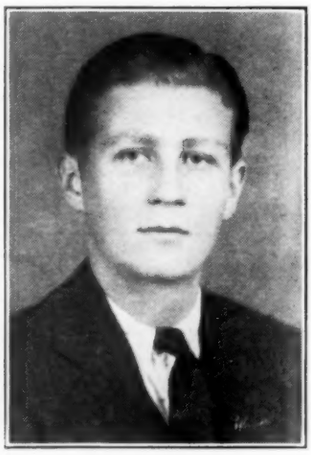
ANACONDA WELDING RODS

Welding Exhibit of H. I. Skilton at Cuban Congress.

the exhibits were continued until the close of this conference. Many papers were presented at both conferences, and a motion picture was shown illustrating a great deal of arc welding being done in connection with the Boulder Dam job, the film being supplied by the Reclamation Department of the U. S. Department of Interior.

Joins Bastian-Blessing Organization

John Clifford Owen, a graduate of the Armour Institute of Technology has joined the organization of The Bastian-Blessing Co., in Chicago, and will devote his efforts to servicing "Rego" customers, says an announcement from E. L. Mills, vice-president of the company. For several years Mr. Owens has been



J. C. OWEN

acquiring field experience with various organizations, which background equips him particularly well to carry on his new work.

USL Welders Now Made by Owen-Dyneto Corporation

USL arc-welding equipment is now being manufactured and sold by the Owen-Dyneto Corp., of Syracuse, N. Y., who have transferred the entire engineering staff, machinery and equipment from Niagara Falls to Syracuse. Owen-Dyneto Corp., like USL Battery Corp., of Niagara Falls, who formerly manufactured the USL welders, is a subsidiary of Electric Auto-Lite, and is engaged in the manufacture of motors, generators, electric windshield wipers, battery-charge regulators, and other electric equipment. A complete new line of arc welders is in process of design, says an announcement from J. L. Fosnight, sales manager.

Omaha Welding Company to Hold Welding Show

A "Welding Confab," including demonstrations and exhibits, will be held by the Omaha Welding Co., 1501 Jackson St., Omaha, Nebr., on March 11th to 13th. Visitors are asked to bring their jobs for welding. Individual instruction will be given. Manufacturers cooperating in this project include the Smith Welding Equipment Corp., Hobart Brothers Co., General Electric Co., Haynes Stellite Co., Central Steel & Wire Co., American Manganese Steel Co., Titan Metal Manufacturing Co., Will-Weld Manufacturing Co., American Steel & Wire Co., The Linde Air Products Co., and Osmundson Spade Manufacturing Co.

The Pier Equipment Manufacturing Co., Benton Harbor, Mich., announce the appointment of several new distributors of their line of spot welders, among them being the Robt. W. Hoffman Co., 13 S. Clinton St., Chicago; Ward Machinery Co., 564 W. Washington Blvd., Chicago; National Supply Co., Toledo, Ohio; Ernest P. Moslo Co., 1865 South Taylor Road, Cleveland Heights, Ohio; Delta Equipment Co., 148 N. Third St., and J. N. Moyer, 465 N. Fifth St., both of Philadelphia; Ideal Machinery Co., 361 W. Market St., Plainville, Conn.; Meyer Machinery Co., 1930 Santa Fe Ave., Los Angeles, Calif., and West Coast Machinery Co., 1006 First Ave. S., Seattle, Wash.

The general offices of the Republic Steel Corp. have been removed from Youngstown to Cleveland, Ohio, where the company occupies floors 13 to 16, inclusive, in the former Medical Arts Building, recently renamed the Republic Building, says an announcement by T. M. Girdler, president and chairman of the board. This move consolidates the general offices, the executive and Cleveland district sales offices, and the advertising department, formerly located in Massillon, Ohio. The sales offices of the Alloy Steel Division of Republic will remain in Massillon.

The Chicago office of the J. D. Adams Co., of Indianapolis, Ind., has been removed to 1500 S. Western Ave., where larger quarters are available. The move was necessitated by increases in business in the Chicago area, reports P. E. Hall, manager of welding sales. Complete stocks of electrodes and welding equipment will be maintained. A. T. Cox, Jr., remains as sales engineer in charge of the southern part of the territory, with Frank J. Hoffmann added to the force as sales engineer covering the northern part.

The Hobart Brothers Co., Troy, Ohio, announce that the J. C. Gowing Welding Equipment & Supply Co., has been appointed exclusive distributor for "Hobart" arc welders in southern California. The new location of the Gowing company is at the corner of Laura and Regent, Huntington Park. Jim Gowing, manager, has been active in the welding field in and around Los Angeles for the past eight years.

The New York Welding Supply Co., New York, N. Y., has engaged two additional salesmen to take care of increased business. The sale of 14 new Westinghouse arc welders is reported by this organization for the period from Jan. 1st to Feb. 15th. Sales quarters have been enlarged and space devoted to offices has been doubled. W. F. Dusenbury, president, is quoted as saying that 1936 is expected to surpass in sales any year since 1930.

With a cutting and welding show held in the El Paso Vocational School, El Paso, Texas, on Dec. 6th, the Air Reduction Sales Co. completed a series of 166 shows during 1935, with a total attendance of 70,524, representing an average attendance per show of 424. The itinerary covered every district in the Aireo organization, from border to border and coast to coast.

The New Process Plow Welding Co., Perry, Iowa, have been made distributors of the sheet-metal-working equipment made by the Glascock Brothers Manufacturing Co., Muncie, Ind., including spot welders, metal-forming presses, jig shears, and paint spray tables.

The Pier Equipment Manufacturing Co., Benton Harbor, Mich., manufactur-

Experienced Welders Prefer

PENN*

doubly deoxidized

Bronze Welding Rods

*Patented Number 2,022,439

(Trade Mark Registered)

Because they produce welds with

Greater Strength

combined with

Greater Ductility

due to the exclusive Double Deoxidation feature, found only in Titan alloys.

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other Titan features include:

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Corrosion Resistance

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Samples of our Penn Bronze, Titan Bronze, Titan Brazing Bronze and Titan Manganese Bronze Alloys, gladly forwarded upon request. Write for descriptive circular.

TITAN METAL MFG. CO.
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Aprons, Gloves, Spats, Sleeves, Leggings.
Welding Hose and Connections.
Torch Lighters, Meters, Gauges.
Acetylene Generators.

MACHINERY AND WELDER CORPORATION

WE RENT WELDING EQUIPMENT

ers of spot welders, have appointed H. J. Scheid, 6641 North 20th St., Philadelphia, Pa., as their district sales representative to service the states of Maryland, New Jersey, Pennsylvania and the metropolitan area of New York. Mr. Scheid will cooperate with distributing dealers in that territory.

The Stulz-Sickles Co., Newark, N. J., has appointed the following as distributors of Manganal products: Young & Van Supply Co., Birmingham, Ala.; Tennessee Armature & Motor Works, 416 W. Jackson St., Knoxville, Tenn.; and Globe Machinery & Supply Co., 205-211 West Court Ave., Des Moines, Iowa.

Charles W. East has been appointed district sales manager of the Republic Steel Corp. at Houston, Texas, succeeding Robert E. Lanier, who has resigned. Mr. East was for many years located in the Birmingham, Ala., office of Republic.

Roy Thomas, of the Torch Shop, 1637 E. Vernon Ave., Los Angeles, Calif., local distributor of the "Will-Weld" electric welder, announces the appointment of George Roberts as director of sales in the Los Angeles territory.

The Clark Tructractor Co., Battle Creek, Mich., announces that Harry B. Clapp has joined its staff as transportation engineer, and will act as special engineering assistant to Ezra W. Clark, vice-president.

The Welding Equipment & Supply Co., formerly located at 3524 East 74th St., Cleveland, Ohio, recently moved to 1034 St. Clair Ave., says an announcement from O. F. Fathauer, secretary of the company.

The Will-Weld Manufacturing Co., Inc., Omaha, Nebr., has appointed R. E. Craig, of 2057 Marengo Ave., So. Pasadena, Calif., as Pacific Coast distributor of their line of a.c. electric-welding units.

The Stulz-Sickles Co., Newark, N. J., has opened a branch office at 109 South 21st St., Birmingham, Ala., with J. Mayer as district sales manager.

Williams & Co., Inc., of Pittsburgh, Cleveland and Cincinnati, have been appointed distributors for Westinghouse FlexArc welders.

Notes From the Field

Denver Firm Does Quick Repair Job in Dakota

By W. B. SHERRILL

Pandemonium broke loose in the engine-room of the Dakota Power Co., Rapid City, S. Dak., when a connecting rod assembly broke loose in the giant Diesel plant that formed the backbone of the power output. Crash! and right through the side wall of the plant went the piston, connecting rod and all, bringing with it the shattered remains of the steel engine wall.

Quickly shutting down the plant, the superintendent put in a long distance call to Herman Flader, owner of the National Welding Co., Denver, Colo., and expert welder himself.

"Flader?" the anxious voice of the superintendent came over the long-distance wire. "Flader, pack your equipment and catch the next train to Rapid City. A con rod's just broken loose in the main Diesel here and the whole thing's out on the engine-room floor. It's a hell of a mess, Herman; $90,000 worth of equipment junked unless you can save it for us."

Hurriedly packing a large tool box with torches and special heads, Mr. Flader entrained for Rapid City on the next train out of Denver. Arriving there, he was met at the station by the superintendent, who took him directly to the power company's main Diesel room and, with a worried frown on his face, unlocked the engine-room door and told Flader to look at the worst damaged power plant that he would ever see.

Stepping into the room, Flader's eye took in the wreck in a sweeping, comprehensive glance. A gaping hole in the side of the Diesel engine averaging 6 ft. high and 4 ft. wide gave unmistakable evidence as to where the connecting-rod assembly had smashed through when a bolt, tieing it to the crankshaft, had broken loose. Scattered, fanlike, in front of the hole, were over a hundred fragments of the wall, which tended to form a nest for the wrecked and battered piston, connecting rod and assembly.

Carefully matching the hundred-odd small pieces together, Mr. Flader assembled them with a patience and zeal worthy of the most ardent jig-saw picture-puzzle fan. Fitting each small piece into the ragged edge of its neighbor, he eventually completed the pattern and had, on the engine-room floor, the pieced-together section of the engine side wall, measuring roughly 4 ft. across by 6 ft. high.

Setting up his equipment then, he started in to weld the various-sized and rough-edged fragments together. Thus he built up three sections of approximately the same size and weight, dividing the job in this manner so as to facilitate fitting them into the cavity. He knew, from past experience, that it would be much easier to fit three lighter sections into the 6-ft. hole than to strain and tug into place the one large section with its forbidding weight.

Finishing up the three sections, he hoisted the bottom one into place and securely welded it there. Then the middle one was fitted into its place on top of the first section and securely welded. The last of the three sections was then fitted in and the gaping hole closed up.

The finishing off and smoothing up of the numerous welded joints was next accomplished with a portable, powered emery wheel and occasional touch of the torch to flow together some slight depression. Inside and out, the welded section was finished off until the naked eye could never see the evidence that the engine side wall had been worked on at all.

A coating of oil was burned in to further anneal the weld, and then it was burnished to still more completely hide the evidence of any welded spots. This, while in no way essential to the success of the job, was a finishing touch that Flader likes to put on every one of his jobs.

The completed job measured the identical thickness of the original—from 1½ to 3 in., the average thickness being a fraction over 2 in.

Repairs Shovel on Mountain Job in Mid-Winter

By R. B. HUTCHISON

Although in business less than a year, the Acme Welding Co., 15th and Shotwell streets, San Francisco, Calif., have been called upon to do, and have successfully accomplished in record time, some of the most difficult welding jobs in California.

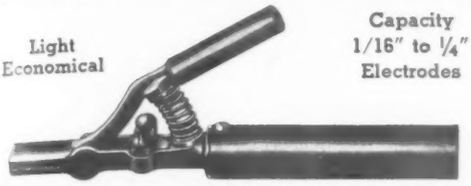
One such job, cited by W. Sommers, owner, was the welding of nearly all the working gear of a gasoline-driven shovel, located on a job near Rock Creek, Calif.

"The shovel had broken down so badly that it was impossible to move it to the shops of the contracting company doing the excavating work. Welding had to be done under the most difficult conditions. Rock Creek is over a mile high in the mountains and it was the middle of winter. There was snow on the ground and temperatures were around zero," explained Sommers.

"We had to travel 240 miles, mostly of mountain road, to get to the job. The shovel had broken down in the middle of the creek bed, and had to be removed from it to get the arc-welding equipment near enough to use it. We used 125 lb. of electrodes in repairing

Welders Prefer these Practical Electrode Holders

"SIMPLEX" Improved Spring-Type Holder



SOLDERED OR MECHANICAL CABLE CONNECTION

Jaws made from copper alloy with 96% copper content, grooved to hold electrode at various angles. Spring entirely insulated. Efficient clamp eliminates removing of fibre handle when making mechanical cable connection.

"EUREKA" the Leading Holder

SOLDERED OR MECHANICAL CABLE CONNECTION

Jaws as well as all other parts easily replaceable at low cost. Cool grip assured by complete circulation of air through fibre handle at all times.

A Trial Will Convince **Jobbers in All Principal Cities**

THE FIBRE-METAL PRODUCTS CO. *Pioneers, Designers and Manufacturers* **Chester, Penna.**

the working gear, and had it in operation again in two days' time."

Failure of the shovel was not due to the breakage of any single part. It was being worked against heavy blocks of granite and had simply worn out. Most of the welding consisted in building up gears, moving parts, and shovel teeth.

In building up the shovel teeth, Sommers and his partner, Alfred Zaft, made use of a method they had previously worked out themselves and used with great success on shovel teeth in the shop. They had shovel-teeth tips specially made of manganese steel to specifications. The old teeth were cut off with the welding torch and the ends of the old teeth were veed out and the new manganese tips welded to them. The weld was then ground down smooth and the whole tip case-hardened. Bucket teeth made in this way are every bit as good as the original ones, according to Sommers. And they are capable of withstanding the same wear as the original teeth.

Two well-known Cleveland welding firms were merged as of Jan. 1, 1936, when Contract Welders, Inc., 4829 Lexington Ave., acquired Industrial Welding & Cutting Co., 4400 Perkins Ave. The two plants will be operated as divisions of Contract Welders, Inc., until April 1st, when equipment and organization will be consolidated as Contract Welders, Inc., in large quarters at 2545 East 79th St., Cleveland. C. C. Peck, president of Contract Welders, Inc., since its founding, will head the consolidation, and Everett Benedict, formerly manager of Industrial Welding & Cutting Co., will serve as vice-president in charge of sales.

A riveted 5-ton coal hopper was recently replaced by an all-welded one at The Century Distilling Co., in Peoria, Ill. After welding this hopper into place, the operator was called on to weld a crack in the tube of a special-built stoker, the flues being constructed of steel, with cast-iron shoes. The crack occurred under the shoe, a very difficult place to reach. After chipping off part of the shoe, the electric arc was applied, and in about five hours the stoker was back in service. Welding was done by The Superior Welding Co., of Peoria.

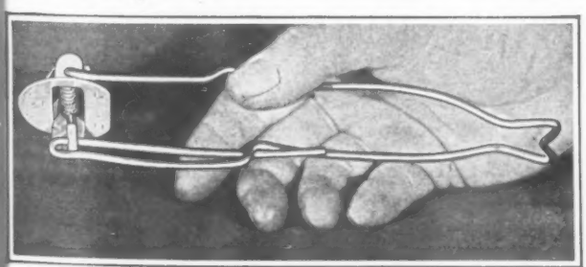
Brown's Midwest Electric Arc Welding Co., 1743 Walnut St., Kansas City, Mo., while doing a general welding business, specializes in structural-steel construction. The decided improvement in the building line is reflected in big gains in that kind of welding work. This company recently completed a pipeline welding job for the Phillips Oil Co. at Paola, Kan., and has secured the welding contract in the structural steel work of the new Wyandotte High School in Kansas City, Kan. This new school building will be the largest in the state of Kansas.

A contract for the construction of a 1408-ft. bridge over the Cimarron River, near Liberal, Kan., has been awarded by the Kansas State Highway Commission to O. O. Fuller, Nevada, Mo. The bridge is to be fabricated almost entirely by the arc-welding process. More than 8,000 lineal feet of welding will be required, the greater portion being vertical and overhead work. The total contract price for the construction of the bridge is $91,784.29. This will be the second welded bridge to be constructed by the Kansas Highway Department.

Omaha's first welded steel home is nearing completion. This is a large two-story dwelling for Paul Engler, of the Balbach Co. The frame is welded to form one piece. Architects and builders assert it will be much more pliable than the steel-frame buildings constructed under the old system of bolting together. Henry B. Neef, of the Gate City Iron Works, Omaha, is superintending the construction. The framework of the house is grounded to combat electrical storms.

The Northern Natural Gas Co., Omaha, Neb., have completed the en-

The Improved "Round File" Gas Lighter



Many superior design and construction features, found only in Improved "Round File," make this lighter the Welder's Favorite.

Hood forms a pocket for gas, insuring immediate ignition.
Larger file area, providing longer life for lighter.
Larger spark metal, which assures many additional ignitions.
Locking slip-on renewal cartridge, permits immediate replacement.
Cadmium plated, preventing rust.
Every part **thoroughly tested.**
Fully guaranteed.

Write for descriptive circulars and prices.

CAUTION: Imitations of the patented Improved "Round File" are on the market. For your protection insist on Safety Gas Lighter Co. patented lighters and genuine Safety Gas Lighter Co. renewals.

ORIGINATORS OF THE HAND GAS LIGHTERS **SAFETY GAS LIGHTER CO.** Est. 1901 **LYNN, MASS.**

largement of their natural-gas booster station at Mullinville, Kan. Considerable electric and oxyacetylene welding was required in making the plant addition. It is reported that the company is to let contracts shortly for the construction of another 24-in. pipeline from their holdings in Stevens County, Kan., to the Mullinville Station. The line will parallel their present pipeline, which is approximately 200 miles in length.

A well-known Kansas-oilfield machine-shop operator who has been purchasing considerable electric-welding equipment says there is still an improvement for electric-welder manufacturers to bring out. He says he will buy the first machine put on the market that will enable him to make a central plant setup for his various shops and tune in for welding current when and wherever he wants it. Now that would be something! One skeptic says it would put all of the radios on the blink.

A 200-ton hydraulic press, constructed principally by arc welding, was recently completed by the Orange County Machine Works, of Santa Ana, Calif., for their shop. The main frame members comprised 20-in. I-beams, 15-in. channels and ½-in. steel plate. The press will be used principally for pushing pins and bushings from crawler-type tractors, and general wheel work. J. C. Coombs and E. W. Danielson are joint partners of the concern.

A contract for the construction of an oil tank barge, representing an outlay of approximately $50,000, has been awarded the Pennsylvania Shipping Yards, of Beaumont, Texas, by the Texas Oil Co. The Samuelson staggered butt-weld system will be used, and the barge will be equipped with Mathis patented skegs, on either side, for keeping it straight. The dimensions are approximately 210 ft. long, by 40 ft wide, by 11 ft. deep.

The Geo. C. Christopher & Son Iron Works of Wichita, Kan., has been building a considerable amount of all-arc-welded steel handrail for bridges and overpass structures. Their last job, totaling 4500 lineal feet, was erected on the Hutchinson, Kan., overpass. They are now working on a 1700-ft. job for a new state highway bridge at Winfield, Kan.

The Standard Oil Company of New Jersey is reported to be in the market for the purchase of four all-welded oil barges, with alternate bids asked for on riveted construction. Three of the barges will have capacities of 5,000 barrels each, and the other one 10,000 barrels. It is understood that the barges are for use in Southern inland waterways. Subsidiaries of the company have quite a number of oil barges in service.

That quality work will bring customers is proven by the experience of The Covington Welding Co., 31 E. 5th St., Covington, Ky. Customers are given a square deal and then they tell others about the shop, and as a result this plant has been extremely busy, according to Al Grause, proprietor. Approximately 75% of this shop's work involves automobile repairs.

J. F. Minnotte, head of the Pittsburgh, Pa., Section of the American Welding Society, blames the rigidity of the city building code for the relative lack of structural welding in Pittsburgh. Many efforts have been made to combat this difficulty, but little progress has resulted. A committee was appointed some years ago, representing 12 technical societies, to revise the code in favor of welding, but did not meet with success.

The Dayton Wheel & Rim Co., 414 S. Ludlow St., Dayton, Ohio, is engaged in the business of aligning and repairing bad automobile wheels. One of the things they encounter frequently is the cracking of disc wheels on some of the later-model autos. They handle this difficulty by first setting the wheel to be repaired into its true alignment by means of presses. Then, after the wheel has been lined up, they weld all breaks in it.

Douglas Moore and Lee Hoffman have purchased the Godfrey Welding Co., 1508 Harmon Place, Minneapolis, Minn., and have replaced much of the older equipment, adding an acetylene generator, two new oxyacetylene welding and cutting outfits, and two arc welders of their own manufacture. The shop is featuring 24-hour emergency service, and is equipped to handle production welding contracts, says Mr. Moore.

George E. Berry of the United States Bureau of Navigation and Steamboat Inspection, Washington, D. C., spent some time recently at Floreffe, Pa., inspecting some welded material for the Vesta Coal Co., of Pittsburgh, Pa. The Vesta concern is one of the largest mining companies in the Pittsburgh district and is a subsidiary of the Jones & Laughlin Steel Corp. They operate a fleet of river steamers and barges.

J. H. Mohlengraft, who for years has operated a blacksmith shop, and as a side line did small jobs in oxy-acetylene welding, has gone in for welding in earnest by the recent installation of electric welding equipment in his shop located on Valley Blvd., east of Puente, Calif. A 200-ampere portable unit was recently added to his shop equipment, and will be used largely in agricultural implement repair work.

A lot of welding is involved in the manufacture of more than $600,000 worth of tractors and graders to be built by The Caterpillar Tractor Co., of East Peoria, Ill. The contract was recently awarded this company by the United States, for forest service. Included in the order are 185 tractors at $577,304; 2 tractors at $5,914; 21 tractors at $24,775; 3 graders at $11,525; and 13 graders at $12,928.50.

An addition to the R. G. Le Tourneau plant, manufacturers of all-welded road-grading equipment, is nearing completion at North Adams and Grant St., in Peoria, Ill., despite the zero weather. Steel columns to support the roof are going into place. The building will be 300x160 ft., or considerably larger than the parent plant, located in front of it. Fred Harbers Sons Construction Co. have the contract.

D. G. Green, who operated Denny's Welding Works, at 4001 East 9th St., in Los Angeles, Calif., was instantly killed when he was recently struck down by a speeding automobile while crossing the boulevard in front of his place of business. Mr. Green was well known in welding circles in the East-side industrial district of Los Angeles, having for several years operated shops in that section of the city.

A large increase in December business was noted by the Smith Welding & Engineering Co., Denver, Colo. Booms and shovel buckets made up the greatest part of the business. Several times the company had as many as 25 shovel buckets in the shop at one time. The increase in business is attributed to a concentration of public-works projects. Luke E. Smith, owner, is looking ahead to a boom year.

The changing over of the steam lines at the Ohio Soldiers and Sailors Home at Xenia, Ohio, from screw lines to all-welded lines, was recently completed by The New Ideal Welding Co., 344 S. Main St., Dayton, Ohio. It was necessary to keep the steam on during the day, so the work all had to be done by tunneling at night. The job required the work of two men for a little over two weeks.

The forged weld used by the blacksmith still has its place in repair work, according to Jones & Schnell, of 41 W. Monument Ave., Dayton, Ohio, who also do a considerable amount of oxyacetylene welding. Many metal articles which are turned down by other welding shops are brought to this firm, who find the

blacksmith weld to be a most reliable process for repairing broken bumper brackets.

"Stoodite" was used by The Superior Welding Co., 331 Knoxville, Peoria, Ill., to build up the teeth of two sprocket wheels on a tractor, at Edwards Station, Ill. Building up these teeth prevents their cutting the links and pins of the track. New tracks are to be put on this tractor, the track rollers are to be built up and surfaced with "Hardweld," and the drawbars are to be reinforced by welding.

Approximately three months' work was recently given by the Rich Pump & Ladder Co., Cincinnati, Ohio, to Adam Feinauer, Jr., welder at 728 Orchard St., Newport, Ky., who is being engaged to weld up 600 triangle irons for painters' scaffolds. They are made by the oxy-acetylene process, the material being mild steel. The supply will last the Rich concern for approximately a year.

Construction soon will be started on an 8-in. all-welded pipeline from the East Texas field to the refinery of the Humble Oil & Refining Co., at Baytown, a distance of approximately 200 miles. Another job requiring considerable welding will also soon be started by the same company in the construction of a polymerization unit to its refinery. This plant will cost approximately $2,000,000.

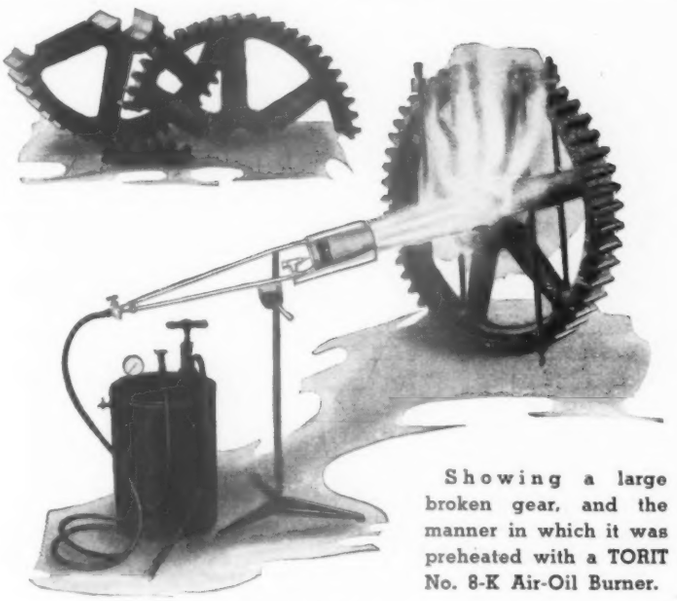
Two stainless-steel manifolds, for large gas furnaces at the Commercial Solvents Corp., Peoria, Ill., were recently welded by the Superior Welding Co., Peoria, the steel being fabricated by the Lucas Iron Works, of Peoria. Orders for four more stainless-steel manifolds of the same size, and several small ones of the same type, have been received by the Superior Welding Co.

The Southern California Gas Co. is at work laying a welded 10-in. pipeline connecting the Semitropic Ridge gas field with the company's 20-in. main transmission line from Kettleman Hills to Taft, Calif. This gathering line will couple up with those of the Standard Oil Co. in the same field, together with other similar lines to be laid in the near future by other oil companies.

Wheels need not be removed from automotive vehicles when welding cracks in their flanges, according to Richard Hartnet, of the Arcade Welding Co., Wellston, Mo. He secures the flange and rim with a vise, then applies a mild-steel electrode, the rim acting as a chill bar, and no metal has to be removed after welding. This concern welds about 50 wheels every month.

PREHEATING . . . .

For Better Welding and Brazing!



Showing a large broken gear, and the manner in which it was preheated with a TORIT No. 8-K Air-Oil Burner.

Jobs like this quickly pay for an outfit.

Preheating is ABSOLUTELY NECESSARY for certain kinds of welding and brazing. Preheating helps the welder do BETTER work—it eliminates strains and contortion—it aids in producing SOFT, yet TOUGH, welds. Preheating not only aids in doing BETTER work, but it saves lots of gas and labor—and, it is very economical!

This welding shop finds plenty of work for its several TORIT Air-Oil Burners, which are shown KEEPING THE JOBS HOT while the welding and brazing are being done.

Ask us for information on TORIT Air-Oil Burners

Made by the St. Paul Welding & Mfg. Co., operating the largest job-welding shop in the Northwest.

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Ryerson Engineers have developed a series of rods that are outstanding for quality production. They are continually checking, testing, and improving—to develop rods that will do specific types of work, faster and better.

Bring your welding rod problem to Ryerson. Let our engineers work with you. You can be sure of finding the right rod for each particular class of work. We will also gladly furnish samples for test. Address the nearest Ryerson plant.

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Ryerson Bare Mild Steel
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Ryerson Copper Coated No. 210
Ryerson Cast Iron
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JOSEPH T. RYERSON & SON, Inc.

Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo Boston, Philadelphia, Jersey City.

The Dravo Contracting Co., of Pittsburgh, Pa., are putting the finishing touches on a new tow-boat for the Monongahela and Ohio Dredging Co., also of Pittsburgh, which will be launched early in March at their marine ways at Neville Island on the Ohio river. The new boat, which has a welded hull, is 90 ft. long and 22 ft. wide, and is of the stern-wheel type.

The O. K. Compressor Exchange, which has its shop on Maple St., in Dayton, Ohio, doesn't do a general welding business, but they are presented with problems galore in welding shut the holes in some of the tanks they use. This company's business is the building up of compressors from used parts and tanks.

A large cast-iron-cutting job was recently completed in the dismantling of the large Pacific Electric Street Railway generating plant at 6th St. and Central Ave., in Los Angeles, Calif. A 1,000-ampere cutting machine, furnished by the Electric Cutting & Welding Co., of Bell, Calif., handled the work of cutting some 3,000 tons of cast-iron machinery and equipment.

C. W. ("Bill") Granneman, well-known welding-shop proprietor on South Santa Fe Ave., in Los Angeles, has moved from his old location at 2900 across the street to No. 2901. "Bill" specializes in aluminum welding in heavy industrial jobs, such as for the Los Angeles Railway and large truck companies, fully 85% of his work being of this type.

Plans and specifications are being prepared by the United States Army engineers' office in Pittsburgh, Pa., for three steel dump scows for use on the lower Ohio River in the vicinity of Louisville. Bids will be asked on both welded bottom and riveted types. These scows will be 120 ft. long, 26 ft. wide and 8 ft. deep, and will each have a capacity of 250 cu. yd.

Construction is under way near Kilgore, Texas, of a new casinghead-gasoline plant. The plant, costing approximately $600,000, is being built by the Gilliland General Crude Oil Co., and will have a daily capacity of 60,000 gallons of gasoline. Electric welding will be used extensively in the erection of the plant and installation of its equipment.

The Marietta Manufacturing Co. have recalled about 200 men to their plant at Point Pleasant, W. Va., as a result of increased orders. The company recently received a contract to build three welded oil barges for the International Petroleum Corp. of Canada, bringing the total under construction for the South American oil trade up to 14 barges.

The New York Rapid Transit has awarded a contract for 15 cars (quintuplet units), each consisting of 5 small units, making a total of 75 units, to the Pullman-Standard Car Manufacturing Co., Chicago. High-strength, low-alloy steels will be used for the bodies, fabricated by spot welding and riveting. All trucks will be built up from plates and rolled shapes, assembled by welding.

G. W. Carl, formerly operating a welding shop at 409 W. Philadelphia, in Whittier, Calif., has disposed of his shop equipment to a Mr. Blackman, who will continue to operate the shop at this location under the name of Blackman's Welding Shop. Mr. Carl has accepted a position with the Crum-Brainard Machine Shop, in Whittier.

Cecil and John Morgan have just established their machine and welding shop at Ellinwood, Kan. They are specializing in reconditioning drill pipe and other general oil-field machine work. A new portable 300-ampere d.c. welder enables them to do any electric welding job. The two brothers report a nice opening business.

An unusual use of welding has been reported in the sale of arc-welding equipment to the Lenawee County Road Commission at Adrian, Mich., for the manufacture of snow plows. The Commission has decided to fabricate its own plows, and has so far constructed eight this season with the use of the new equipment.

The Washington Welding Works, 1223 W. Sprague, Spokane, Wash., has discovered the secret of making a tiny ad stand out in a page of advertising. The secret is a prominent black heart that occupies nearly half of the 2x1-in. space. On it is the company's slogan, "We Weld Anything But a Broken Heart."

A new gas furnace of all-welded construction, lined with firebrick and having monel tubes and stainless-steel manifolds, has been installed at The Commercial Solvents Corp., Peoria, Ill. This is the sixth unit of the furnace building. The tubes and manifolds were all welded by The Superior Welding Co., of Peoria.

The A. C. Woods Co., of Rockford, Ill., are going into the fabrication of machine bases, gears, and machine parts, to meet a growing demand for such parts to be built up from rolled steel and assembled by welding, says R. N. Woods, a member of the firm. A No. 6

Oxygraph has been installed for machine gas cutting on this work.

A welded 4-in. gas line 35 miles in length has just been completed in Hidalgo County, Texas, by the Hidalgo Gas Co. The line will convey gas from the Samfordyce oil field to industrial plants in the vicinity of McAllen. The same company also recently completed a similar line to Port Isabel.

A huge contract for lap-welded steel pipe has been received by the Wheeling Steel Corp., of Wheeling, W. Va., from the engineers' division of the United States Army. The pipe will be used for irrigation work in New Mexico. The order calls for 160,000 lineal feet, with a diameter of 6⅝ in.

Jason Walker, recently associated with the Emil Howe Welding Works, of 9th & Mateo Sts., Los Angeles, Calif., has resigned and taken charge of the welding department of Georges Repair Works, at 587 Harbor Blvd., in Santa Ana. A portable electric welder was recently installed.

The Olson Drilling Co., Burrton, Kan., have been using a considerable amount of arc welding in utilizing their oil-well-drilling draw-works. Practically all machinery necessary for drilling a well is mounted on one steel skid, which is easily and quickly moved from one location to another.

A. E. Miller, 2830 Smithville Road, Dayton, Ohio, reports a decrease in the amount of welding necessary on the average auto wreck. "A. E.," who specialized in welding work on wrecked autos, thinks that this is due to better welding practice in automobile manufacturing plants.

A steel warehouse in Portland, Ore., did 96,000 in. of cutting on their Tractograph oxyacetylene cutting machine in the year 1935. If the average thickness of steel plate cut were, say, ¾ in., the oxygen consumption of the machine for the year should not have been far from 16,000 cu. ft.

The Industrial Fuel Co., of Los Angeles, Calif., has just completed the construction of a 22-mile, 10-in. welded gas line, extending from the Mountain View Oil field to a point near Wheeler Ridge, where it connects with the company's 26-in. trunk line running to Los Angeles and vicinity.

O. G. Stansbro, of Anaheim, Calif., recently took over the management of the welding shop owned by Pressell, Perry & Tull, at 123 S. Clementine St. Mr. Stansbro managed this shop for a number of years, but for the past several months has been engaged elsewhere.

The Houston (Texas) Natural Gas System, Inc., has completed plans for a welded steel pipeline to extend from the natural-gas field near Port Lavaca, Tex., to that city and vicinity. The project will include a welded distributing system for the city and surrounding territory.

The Cody Boiler Works recently removed from their old location at 511 West 4th St. to 2120 Wyandotte St. In addition to being more central and accessible, the new location will increase the company's floor space from 3,000 sq. ft. to approximately 15,000 sq. ft.

A one-story building at 2547 East 79th St., Cleveland, Ohio, containing 12,000 sq. ft. of space, has been leased by the Contract Welders, Inc., who have outgrown their 6,000-ft. space at 4829 Lexington Ave. The lease is for a term of five years at a rental of $8,000 for the term.

C. J. Nyquist, manager of the Weldcraft Service & Supply Co., Los Angeles, Calif., formerly operating at 2440 East 14th St., announces the removal of his business to 1218 Long Beach Ave., in Los Angeles, where larger and much more commodious quarters are available.

INTRODUCING WILL-WELD DISTRIBUTORS

WILL-WELD is proud of the fact that the majority of our distributors have had years of experience in the welding equipment field—that their judgment can be relied upon to be competent—and that such judgment has prompted them to represent us in the low priced A. C. welder field.

Our distributors are jealous of their reputation for selling quality merchandise—they expect to stand squarely behind every sale they make. They know that comebacks and replacements cost far too much in customer good-will to take chances on inferior merchandise, even though immediate profits may look to be extremely attractive. They are always mindful of the "long pull," as are we.

Following is a list of the recognized leading distributors of welding equipment in their respective areas—they are Will-Weld Distributors:

Alamo Iron Works	San Antonio, Texas
Ballou & Wright	Seattle, Wash., and Portland, Ore.
Central Auto Equipment Co.	Springfield, Ill.
Commercial Gas Co.	Minneapolis, Minn.
Compressed Industrial Gases, Inc.	Chicago and Burdette Branches
Gibson Co., The	Indianapolis, Ind., and Branches
Hardware Supply Co.	Terre Haute, Ind.
Hays Supply Co.	Memphis, Tenn.
Herring-Wissler Co.	Des Moines, Iowa
Johnson Welding Equipment Co.	Chicago, Ill.
Massey Hardware Co.	Wichita, Kans.
Michigan Gases, Inc.	Grand Rapids, Mich., and Branches
Neill-LaVielle Supply Co.	Louisville, Ky.
Omaha Welding Co.	Omaha, Nebr.
Orr Iron Co.	Evansville, Ind.
Peerless Supply Co.	Shreveport, La.
Ross-Frazier Iron Co.	St. Joseph, Mo.
The Sidles Co.	Lincoln, Nebr., and Branches
Sioux City Iron Co.	Sioux City, Iowa
Smithweld Equipment Co.	Ft. Worth, Texas
Stowe Hardware & Supply Co.	Kansas City, Mo.
Sutton-Garten Co.	Indianapolis, Ind.
Torch Supply & Eng. Co.	Los Angeles, Calif.
Welding Service, Inc.	San Francisco, Calif.
Winter Co., Karl	Salt Lake City, Utah
Wisconsin Ox-Hyd. Co.	Kenosha, Wisc.

JOBBERS—Write for information on territory open.

WILL-WELD MANUFACTURING COMPANY, Inc.

1501 JACKSON STREET - - - OMAHA, NEBRASKA

"Only Will-Weld Has Impedance Control"

Five teeth of a large gear in a gasoline shovel at Chillicothe, Ill., were recently repaired by welding, by the Superior Welding Co., of Peoria. Three of the teeth were built up with hard-facing rod, and the others were welded where they had been cracked.

H. A. Miller, 1110 Watervliet Ave., Dayton, Ohio, makes a specialty of welding small washing-machine parts, such as driving arms. Since these parts are easily burned, Miller has gained quite a reputation among those who have taken their work to him.

A 166-mile welded pipeline for crude oil was recently laid in Sumatra, which is an island in the Dutch East Indies. The construction required the clearing of a road along the right-of-way, through jungles and swamps, and 19 bridges had to be constructed.

P. L. Greenwalt, of Winfield, Kan., is sporting a new 300-ampere gasoline-engine welder. Pierre believes in lots of power, so he hooked up a thoroughly reconditioned Stutz Eight. He reports that when he strikes an arc it purrs like a kitten.

Unitizing drilling draw-works has provided a nice lot of work for the larger machine and welding shops in the Kansas oil fields. Each unit requires considerable electric welding fabrication as well as machine work in reconditioning.

W. D. Kline, owner and manager of the Kansas City Welding & Machine Works, 1710 Walnut St., Kansas City, Mo., reports that his concern, which specializes in pipeline construction work, has been kept busy on several contracts.

Ernest Kretz, formerly machine-shop superintendent for the Hutchinson Foundry & Steel Co., Hutchinson, Kan., recently opened his own welding and machine shop. He is associated with Whitlock-Adams, Welders.

A new shop has been opened by Harold Sheldon to be known as the Atomic Welders, Inc., at 120 W. Montcalm St., Detroit, Mich. George Catte, formerly with the Hudson Motor Car Co., is manager. The shop will do general welding and also will specialize in tool and die work.

U. H. Hunt has organized the Hunt Portable Welding Co., located at 35th St. and Roanoke Road, in Kansas City, Mo. For the past seven years Mr. Hunt was connected with several Kansas City concerns as a welder.

Eddie's Welding Shop, owned by Ed. Anderson, formerly associated with Emil Howe Welding Works at Matio & 9th St. in Los Angeles, Calif., has been opened for business at 1505 Santa Fe Ave., in Los Angeles.

The welding shop and business of J. E. Maxey, 3520 E. Gage Ave., Bell, Calif., has been taken over by J. W. Connell. Mr. Connell was formerly associated with Mr. Maxey in the shop.

Barney Cruise has moved his welding shop from 4436 W. Madison St., Chicago, to 4918 W. Madison, where he has larger quarters. He recently added all modern electric equipment.

The Lakeside Welding Co., of Cleveland, Ohio, has leased, with option to purchase, the former plant of the Globe Brass & Aluminum Foundry Co., in Cleveland, it is reported.

Johnie's Garage, a concern doing welding work, recently removed from their old location at 6th and Barnett Aves., Kansas City, Kan., to 845 Minnesota Ave.

The Kaw Pipe Line Co., of Kansas, recently completed the welding of a 9-mile, 8-in. oil pipeline extending from Chase, Kan., to the Russell County oil fields.

J. D. Pittel has succeeded Harold Fyllot as superintendent of the welding department of the Midwest Transfer & Garage, 1508 Oak St., Kansas City, Mo.

A. R. Gustafson, welding-shop proprietor of Moline, Ill., states that he has changed the name of his shop to Moline Welding Service.

The Wheatley Bros. Machine Shop, 2505 Broadway, Kansas City, Mo., has added a welding department.

· CLASSIFIED ADS ·

Help Wanted—75c per line, minimum 4 lines. Jobs Wanted—4 lines free. Other Ads—$1.00 per line, minimum 4 lines. Count 8 words to line. Add 6 words for keyed address.

FOR SALE

Arc Welders—Westinghouse 750-amp., 60-65 volt synchronous-driven multiple-operator motor-generator, suitable for ten operators. Can be inspected running at Electric Arc, 152 Jelliff Ave., Newark, N. J. Also have single-operator Lincoln, Westinghouse, G. E., U. S. L. and Burke motor-generators, generators and gas drives. Will rent; rent to apply against purchase. Electric Arc Cutting & Welding Co., Newark, N. J.

Arc Welders—Three 300-amp. Una welders. Can be used for light work with two operators, or heavy work with one operator. A-1 shape. Also other sizes from 100 to 800 amp., different makes. Service Co., 3741 Cedar Ave., Cleveland, Ohio.

Arc-Welding Equipment—5000 ft. super flexible cable. 325 electrode holders. 200 helmets. Also 100-amp. and 300-amp. arc welders. Several A. C. welders. Bargains. Write F-4, The Welding Engineer.

Bargains—Demonstrator Arc Welders. Gasoline and electric drive. 30 days' trial. Easy terms if desired. Write Ken's Exchange, Box U-261, Troy, Ohio.

BUSINESS OPPORTUNITY

Metal Spraying Firm, fully equipped, desires partnership with competent welding engineer or would merge with welding firm of good standing. Investment required. References exchanged. State details in your first letter. Address F-2, The Welding Engineer.

HELP WANTED

Acetylene Welder—Must be thoroughly experienced in job shop work with heavy and light castings. Vicinity of Philadelphia. Give complete details. Address F-1, The Welding Engineer.

Wanted—Chemist or Metallurgist, to develop coatings for shielded-arc welding electrodes. Address Ja-1, The Welding Engineer.

Wanted—A quantitative chemist, preferably one experienced in electrodes. Address F-3, The Welding Engineer.